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SCREENING OF PHILIPPINE PLANTS FOR STEROIDAL SAPOGENINS, I

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ONE TEXT FIGURE

INTRODUCTION

Cortisone, scientifically known as 17-hydroxy-11-dehydrocorticosterone, is an adrenal cortical hormone. It was originally isolated from the cortex of adrenal glands and later synthesized from bile acids of cattle. After its isolation by Kendall, Dr. Hench(6) of the Mayo Clinic headed the group that pioneered its clinical use. Chemists of Merck and Co. participated in the biochemical investigations that resulted in its partial synthesis.

Stimulated by the encouraging effects of cortisone on rheumatic diseases, the search for cheap, abundant, suitable starting materials for its synthesis was intensified. As this hormone belongs to a group of compounds known as steroids, the importance of some saponaceous plants as a possible source of materials for its synthesis is recognized. Steroidal sapogenins occur in plants in a combined glycosidal form which can be cleaved by the use of strong hydrochloric acid. Consequently, the completeness of the acid hydrolysis of the precursor saponins determines the yield of sapogenins.

Marker and Applezweig(4) found that a number of plants growing in Mexico contain steroidal sapogenins and, therefore, provide a source for the synthesis of cortical steroid. Plant families investigated by Marker, et al. include Amaryllidaceæ,

Dioscoreaceæ, Apocynaceæ, and Liliaceæ. Since most of the above-mentioned plant families are also represented in the Philippines, the screening of local plants was undertaken.

This preliminary report includes some species of the families Leguminosæ, Dioscoreaceæ, Amaryllidaceæ, Apocynaceæ, Euphorbiaceæ, Liliaceæ, and Malvaceæ. Plants belonging to other families are scheduled for later screening.

In the course of screening hundreds of plant samples for steroidal sapogenins by Wall, et al.,(8) it became imperative to find a procedure which could be used on large numbers of samples. A much more rapid micro-screening procedure was used since macro-isolation is time-consuming and many species were negative.

EXPERIMENTAL PROCEDURE

Plant samples used in the investigation were collected from the different places in the Philippines and identified according to families, genera, and species. The collection of such plant samples was primarily based on the plants listed by Quisumbing(5) and Brown.(1)

The method finally adopted was based on the studies of Diaz, et al.(2)

Extraction.—The plant material was dried in the oven and powdered in a mortar. An aliquot sample of at least 10 grams was covered with 60 ml of 80 per cent ethyl alcohol and refluxed for 1 hour. The sample was then cooled, filtered, washed, and made to a final volume of 100 ml with 80 per cent ethyl alcohol.

Hemolytic detection of saponins.—Blood Standardization. Ten to 20 ml of whole cow's blood was suspended in 100 ml of 0.85 per cent aqueous sodium chloride solution, the suspension was centrifuged, and the supernatant liquid was decanted. The process was repeated twice. The blood corpuscles were then suspended in 400 ml of 0.85 per cent sodium chloride solution. Ten millimeters of the turbid suspension and 1 ml of digitonin solution (10 mg of pure digitonin in 100 ml of 80 per cent ethyl alcohol) were mixed in a 15-ml conical centrifuge tube. The mixture was kept at room temperature for 5 minutes, and then visually compared with a tube of untreated blood suspension. If complete hemolysis had occurred, the tube containing digitonin would be entirely clear.

In our experience, complete hemolysis by 1 ml of digitonin did not occur. Hence the stock blood suspension was progressively

diluted with 0.85 per cent sodium chloride solution, until 10 ml of the blood suspension were completely hemolyzed at room temperature within 5 minutes.

Detection of saponins.—One milliliter of the plant extract was added to 10 ml of standardized blood suspension. After 5 minutes, the presence or absence of hemolysis was observed. Samples giving a negative test were discarded. Positive extracts were used for detection of steroidal sapogenins.

Isolation of crude sapogenins.—An aliquot of the alcoholic extract equivalent to 5.0 grams or original plant material (moisture-free basis) was concentrated and defatted with benzene saturated with 50 per cent ethyl alcohol. The sapogenins were hydrolyzed with 4 N hydrochloric acid at 75 to 80°C for two hours and the resultant sapogenins extracted with benzene. The benzene extract containing crude sapogenins was placed in a small beaker and evaporated on a steam bath, 2 ml of acetic anhydride were added and the mixture was gently boiled for several minutes. After acetylation, 5 ml of benzene and 5 ml of methanol saturated with potassium hydroxide were added and the contents were mixed vigorously. Immediately, 5 ml of water were added and mixed well and the tube was centrifuged. The benzene layer which separated was withdrawn and the residual aqueous methanol was twice re-extracted with benzene. The combined benzene layers containing the crude sapogenin acetates were evaporated to dryness on a steam bath and dried to constant weight in a vacuum oven at 110°. A yield of crude acetate less than 10 mg meant less than 0.1 per cent pure sapogenin, and the sample was classified as negative for our purposes.

Absorption chromatography.—The sample was dissolved in 5 per cent chloroform in benzene, eluting with this solvent and then with 20 per cent chloroform in benzene in order to remove the monohydroxysapogenins from the column. Chloroform was then used to remove the dihydroxy sapogenins, followed by 20 per cent ethyl alcohol in benzene. Each eluent was collected in separate containers and the solvent was evaporated to dryness.

Spectrophotometric determination.—Henry A. Walens, et al.(7) showed that steroidal sapogenins, on treatment with concentrated sulfuric acid, give characteristic ultraviolet absorption spectra of the sulfuric acid chromogens in the region 220 to 400 mμ. This can be used in the detection and estimation of steroidal sapogenins.

TABLE 1. *Results of hemolysis test and estimated sapogenin content found in the plant collections.*

Species	Local name	Plant part [1]	Hemolysis test	Estimated total m.f.b.
LEGUMINOSÆ				*Per cent*
Abrus precatorius Linn.	Saga	*l*		0
Do	do	*s*		0
Do	do	*sd*	1	0
Acacia concinna (Willd.) DC.	Acacia	*l*	1	0.21
Acacia farnesiana (Linn.) Willd.	Aroma	*fr*	1	0.32
Do	do	*l*		0
Adenanthera intermedia Merr.	Tanglin	*sd*		0
Arachis hypogea Linn.	Mani	*sd*		0
Alysicarpus vaginalis	Mani-manian	*r*		0
Do	do	*l*	1	0
Bauhinia malabarica Roxb.	Alibangbang	*b*		0
Caesalpinia crista Linn.	Kulumbibit	*sd*	1	0.12
Caesalpinia sappan (Linn.)	Sapang	*b*		0
Caesalpinia pulcherrima (Linn.) Sw.	Caballero	*b*		0
Cassia alata Linn.	Acapulco	*l*		0
Cassia fistula Linn.	Fistula	*b*	1	0
Do	do	*s*	1	0.57
Do	do	*l*	1	0
Cajanus cajan (Linn.) Mill.	Kadios	*sd*	1	0
Do	do	*l*		0
Do	do	*s*		0
Cassia tora Linn.	Bulatong-aso	*s*		0
Do	do	*s*		0
Do	do	*l*		0
Do	do	*fr*		0
Chloroa ternatea Linn.	Pukinggan	*l*		0
Do	do	*s*	1	0
Do	do	*rb*	1	0
Dalbergia cumingiana Benth.	Tahid-labuyo	*s*	1	0.36
Desmodium triflorum (Linn.) DC.	Kuliskis-daing	*l*		0
Dolichos lablab Linn.	Batau	*fr*		0
Entada phaseoloides (Linn.) Merr.	Gogo	*b*	1	0.42
Erythrina variegata Linn. var. orientalis (Linn.) Merr.	Dapdap	*l*		0
Do	do	*s*		0
Do	do	*r*		0
Flemingia strobilifera (Linn.) R. Br.	Payung-payang	*l*		0
Do	do	*s*		0
Gliricidia sepium (Jacq.) Steud.	Kakawati	*l*		0
Do	do	*s*		0
Do	do	*b*		0
Indigofera suffruticosa Miller	Tayum	*l*		0
Do	do	*s*		0
Leucaena glauca (Linn.) Benth.	Ipil-ipil	*sd*		0
Mezoneurum latisiliquum (Cav.) Merr.	Dawag	*l*		0
Mezoneurum sumatranum (Roxb.) W. and A.	Sit	*l*		
Mimosa pudica Linn.	Makahia	*l*		0
Do	do	*s*		0
Pachyrrhizus erosus (Linn.) Urb.	Sinkamas	*fr*		0
Do	do	*l*		0
Do	do	*s*		0
Do	do	*bu*	1	0
Paraserianthes falcataria (Blanco) Merr.	Sampaloc-sampalocan	*s*		0
Do	do	*l*		0
Phaseolus aureus Roxb.	Mungo	*sd*		0
Phaseolus lunatus Linn.	Habichelas (red)	*sd*	1	0.30
Pithecolobium dulce (Roxb.) Benth.	Kamachile	*b*	1	0
Phaseolus lunatus Linn.	Habichuelas (white)	*sd*		0
Pongamia pinnata (Linn.) Merr.	Bani	*l*		0
Do	do	*s*		0
Psophocarpus tetragonolobus (Linn.) DC.	Sequidillas	*fr*		0
Pterocarpus indicus Willd.	Narra	*l*		0
Sesbania grandiflora (Linn.) Pers.	Katurai	*l*		0
Do	do	*s*		0

[1] Code for plant parts: *b*, bark; *bu*, bulb; *fr*, fruit; *l*, leaf; *r*, root; *rb*, root-bark; *rh*, rhizome; *s*, stem; *sd*, seed; *t*, tuber.

TABLE 1. *Results of hemolysis test and estimated sapogenin content found in the plant collections*—Continued.

Species	Local name	Plant part[1]	Hemolysis test	Estimated total m.f.b.
Do	do	*b*		0
Tamarindus indica Linn.	Sampaloc	*s,b*	1	0
Do	do	*l*		0
Vigna sesquipedalis Fruw.	Sitao	*sd*	1	0
Vigna sinensis (Linn.) Savi	Paayap	*sd*	1	0
APOCYNACEÆ				
Allamanda cathartica Linn.	Campanilla	*l*		0
Alstonia macrophylla Wall.	Batino	*l*		0
Do	do	*s*		0
Do	do	*b*	1	0.25
Do	do	*fr*		0
Calliaranthus roseus (Linn.) Don	Chichirica	*l*		0
Do	do	*s*		0
Aletonia scholaris (Linn.) R. Br.	Dita	*l*		0
Do	do	*b*	1	0
Kibatalia blancoi (Rolfe) Merr.	Laniting-gubat	*l*	1	0.19
Do	do	*s*		0
Nerium indicum Mill.	Adelfa	*s*		0
Do	do	*l*		0
Do	do	*b*	1	0.98
Paralstonia cluaiacea Baill.	Maladita	*b*	1	0
Plumiera acuminata Ait.	Kalachuche	*l*		0
Do	do	*b*	1	0.40
Tabernaemontana pandacaqui Poir.	Pandakaki	*l*		0
Thevetia peruviana (Pers.) Merr.	Campanero	*l*		0
Do	do	*s*	1	0
Rauvolfia amsoniaefolia A. DC.	Sibakong	*rb*		0
DIOSCOREACEÆ				
Dioscorea alata Linn	Ubi	*t*	1	0.25
Do	do	*l*	1	0
Dioscorea esculenta (Lour.) Burkill	Tugi	*t*	1	0.05
Dioscorea hispida Dennst.	Numi	*t*	1	0.73
AMARYLLIDACEÆ				
Agave cantala Roxb.	Magei	*l*	1	0
Crinum latifolium Linn.	Lirio	*bu*		0
Eurycles amboinensis (Linn.) Lindl.	Cebollas del Monte	*bu*		0
Do	do	*l*		0
Hymenocallis littorale (Jacq.) Salisb.	Spider lily	*bu*		0
Do	do	*l*		0
LILIACEÆ				
Aloe vera Linn.	Sabila	*l*		0
Allium ascalonicum Linn.	Sibuyas tagalog	*bu*		0
Allium cepa Linn.	Sibuyas bumbay	*bu*		0
Allium odorum Linn.	Kuchai	*l*		0
Allium sativum Linn.	Bawang	*bu*		0
Asparagus plumosus Baker	Asparagus fern	*l*		0
Do	do	*fr*	1	0
Cordyline fruticosa (Linn.) A. Chev.	Sagilala	*l*		0
MALVACEÆ				
Abutilon indicum (Linn.) Sweet	Malbas	*l*		0
Do	do	*s*	1	0
Do	do	*fr*		0
Hibiscus rosasinensis Linn.	Gumamela	*l*		0
Do	do	*s*		0
Sida acuta Burm. f.	Walliwallisan	*l*		0
Do	do	*s*		0
Do	do	*r*		0
Thespesia populnea (Linn.) Soland.	Banalo	*r*	1	0
Do	do	*s*	1	0

TABLE 1. *Results of hemolysis test and estimated sapogenin content found in the plant collections*—Continued.

Species	Local name	Plant part	Hemolysis test	Estimated total m.f.b.
EUPHORBIACEÆ				
Antidesma bunius (Linn.) Spr.	Bignai	*l*	1	0
Bregmia rhamnoides (Retz.) Muell.-Arg.	Mutang-hipon	*l*		0
Do	do	*s*		0
Euphorbia neriifolia Linn.	Soro-soro	*l*		0
Do	do	*s*		0
Euphorbia pulcherrima Willd.	Pascua	*l*		0
Do	do	*s*		0
Euphorbia tirucalli Linn.	Suerda	*s*	1	0
Excoecaria agallocha Linn.	Buta-buta	*l*		0·10
Do	do	*s*		0
Jatropha curcas Linn.	Tubang-bakod	*l*	1	0
Do	do	*s*	1	0
Do	do	*b*	1	0·90
Macaranga tanarius (Linn.) Muell.-Arg.	Binoñga	*l*		0·15
Do	do	*s*	1	0
Do	do	*b*	1	0
Manihot esculenta Crantz.	Kamoteng-kahoy	*l*		0·95
Do	do	*l*		0
Do	do	*s*	1	0
Pedilanthus tithymaloides (Linn.) Poit.	Lubang-dulaga	*l*		0
Do	do	*s*		0
Ricinus communis Linn.	Tañgan-tañgan	*l*		0
Do	do	*s*	1	0
Do	do	*sd*		0·51

The sample, preferably 5.0 mg, was weighed into a 10-ml volumetric flask and dissolved in chloroform. The solvent was evaporated to dryness. Sulfuric acid, 94 per cent by volume, was added to the 10-ml mark. The flask was then immersed for 16 hours in a constant-temperature bath at 40°C. The flask and contents were then cooled to room temperature and the contents diluted, if necessary, to volume with 94 per cent sulfuric acid.

The sapogenins in the sample were determined qualitatively by the use of the Beckman DU spectrophotometer.

RESULTS AND DISCUSSIONS

The results obtained from one hundred thirty-nine extracts prepared from different parts of eighty-three local plants investigated are shown in Table 1. Forty-five alcoholic extracts were positive in the hemolysis test. Seven plants of the Leguminosæ family, 4 plants of the Apocynaceæ, 3 of the Dioscoreaceæ, and 5 of the Euphorbiaceæ, gave positive results in the spectrophotometric determination. Plant samples under the families Liliaceæ, Amaryllidaceæ, and Malvaceæ were found to be negative.

The ultraviolet spectrum of the solution, relative to the pure solvent, was obtained from 220 to 400 mμ in a 1-mm cell and examined for the presence of the characteristic sapogenin absorption bands. Fig. 1 shows the absorption maxima of nami

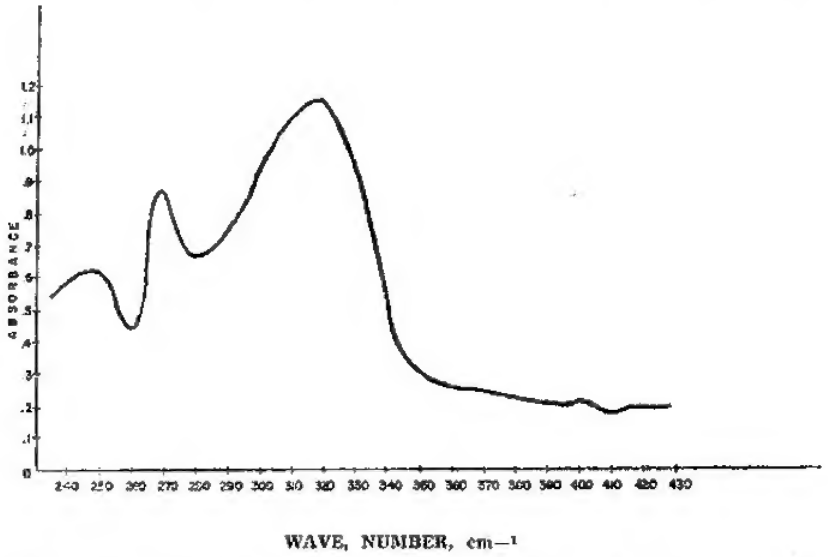

FIG. 1. Absorption spectra of *Dioscorea hispida* Dennst. (nami) tuber.

tuber at 250, 270, 320, 400, and 415 mμ. By comparison with the standard maxima given in Table 2, the sapogenin content of the solution can be qualitatively determined.

TABLE 2.—*Wave length positions and intensities of absorption maxima of sulfuric acid chromogens of steroidal sapogenins.*

Sapogenin	Absorption maxima, Mμ
Chlorogenin	270,330,415
Diosgenin	271,415,514
Gitogenin	272,308
Hecogenin	276,350,396
Kammogenin	233,272,349
Kryptogenin	280,383
Manogenin	276,348,400,468
Markogenin	270,308
Rockogenin	273,379
Samogenin	270,308
Sarsasapogenin	271,310
Smilagenin	272,312
Tigogenin	270,312
Yuccagenin	240,268,405

For an approximate determination of the quantity of sapogenin in the sample, it is measured at 250 m using the absorption coefficients given in Table 3. The concentration of sapogenin

TABLE 3.—*Absorptivities of steroidal sapogenins at 250 and 350 mμ.*[a]

Sapogenin	Absorption coefficients 250 mμ	350 m
Chlorogenin	16.0	18.4
Diosgenin	18.4	14.6
Gitogenin	18.1	8.8
Hecogenin	16.8	29.6
Kammogenin	18.3	17.5
Kryptogenin	9.9	12.3
Manogenin	15.3	23.3
Markogenin	16.6	10.9
Rockogenin	17.9	22.4
Sammogenin	17.2	12.0
Sarsasapogenin	15.3	13.9
Smilagenin	16.4	13.9
Tigogenin	15.7	13.9
Yuccagenin	28.0	12.4

[a] Absorbtivity is defined as $a = A/bc$ where A is the absorbance of a solution of thickness b (centimeters) and c grams per liter compared with an equal thickness of solvent.

was computed by the following formula adopted by Wall, et al.:

$$c = \frac{A}{ab}$$

where,

a = absorptivity coefficient
A = absorbance
b = thickness of cell in cm
c = concentration of sapogenin in grams/liter

In the case of samples that contain mixtures of steroidal sapogenins the absorption coefficients of which are quite far apart, estimation is not satisfactory without preliminary separation into individual sapogenins. However, from the spectral curves taken, conclusions can be drawn whether such samples contain appreciable amounts of steroidal sapogenins.

SUMMARY

Different parts of eighty-three local plant materials belonging to the families Leguminosæ, Apocynaceæ, Dioscoreceæ, Amaryllidaceæ, Liliaceæ, Malvaceæ, and Euphorbiaceæ were extracted with 80 per cent ethyl alcohol. One hundred thirty-nine extracts

were obtained and all were subjected to hemolysis test. Forty-five alcoholic extracts gave positive results. Positive samples were isolated for their crude sapogenin acetates. Adsorption chromatography using activated alumina as the adsorbing agent removed substances or resins which would react with the sulfuric acid remaining in the sample. At the same time, it separated the monohydroxy from the dihydroxy sapogenins which made identification of steroidal sapogenins easier. Nineteen out of the forty-five that were isolated gave steroidal sapogenin spectral curves in the region of 220 to 400 mμ. Some of these are the barks of *Nerium indicum* Mill. (adelfa), *Jatropha curcas* Linn. (tubang-bakod), *Macaranga tanarius* (Linn.) Muell.-Arg. (binoñga), and the tubers of *Dioscorea hispida* Dennst. (nami). Plant samples investigated under the families Liliaceæ, Amaryllidaceæ, and Malvaceæ were found to contain no steroidal sapogenins.

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NEOTYPES OF SOME PHILIPPINE BIRDS

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INTRODUCTION

The organization of the former Bureau of Science in Manila was one of the noteworthy achievements of the Philippine Government under the American regime. Among the various activities of that Bureau (now the Institute of Science and Technology) were the explorations and researches it undertook to determine the natural resources of the country, and the maintenance of a collection of natural history objects. Being a naturalist, Dean C. Worcester, one of those who helped organize the civil government, saw to it that natural history was given prominence in the set-up of the Bureau of Science.

Richard C. McGregor was recruited from the United States to undertake studies on Philippine birds. Together with his Filipino assistants, principally Andres Celestino, Mariano Canton, and later Francisco Rivera, McGregor traveled the length and breadth of the Philippines to collect natural history objects, principally birds. His activities for over thirty years resulted in the establishment in Manila of the finest collection of Philippine birds, containing about 25,000 skins. Included in that collection were all the types described by McGregor himself, and some of those named by Marquess Hachisuka when he visited the Philippines in 1929. The writer also described a few new forms from this collection. All these materials together with nearly the entire contents of the then Bureau of Science were destroyed during the Battle of Manila in February, 1945.

The National Museum, which undertakes systematic studies on the natural history of the Philippines, is being rebuilt slowly due to the fact that priority is given to the economic rehabilitation of the country. Thanks to the help of other museums, such as the American Museum of Natural History, the Chicago Natural History Museum, the University of Michigan Museum of Zoology, and friends, like Capt. Harry Hoogstraal, leader of the Philippine Zoological Expedition of 1946 sponsored jointly

by the Chicago Natural History Museum and the Philippine National Museum, and Prof. Dioscoro S. Rabor of Silliman University, Dumaguete City, the bird collection of the Museum, although still inadequate, has been partly replenished. The author wishes to express his sincerest appreciation to these institutions and individuals, without whose cooperation the preparation of this paper could not have been possible.

This paper records the neotypes of birds now found in the National Museum.

For convenience, the following abbreviations have been used in the text: P. M. for Philippine Museum, the forerunner of the former Bureau of Science; B. S. for Bureau of Science; P. N. M. for Philippine National Museum; and P. Z. E. for Philippine Zoological Expedition.

PHAPITRERON LEUCOTIS MINDORENSIS Hachisuka.

Phapitreron leucotis mindorensis HACHISUKA, Contrib. Bds. Philippines. Suppl. No. 2, Publ. 14 (1930) 146.

Type.—B. S. 4894 R. C. McGregor, et al., ♂ ; Balete, Rio Baco, Mindoro; April 11, 1905.

Neotype.—P. N. M. 0–1226 ad. M. Celestino & A. P. Castro, ♂ ; Naujan Mindoro; September 2, 1947.

PHAPITRERON LEUCOTIS LIMUCON Hachisuka.

Phapitreron leucotis limucon HACHISUKA, Contrib. Bds. Philippines. Suppl. No. 2, Publ. 14 (1930) 146.

Type.—B. S. 10920 A. Celestino & M. Canton, ♀ ; Badajoz, Tablas Is.; September 18, 1905.

Neotype.—P. N. M. 0–4801 ad. T. Aane, ♀ ; Tablas Is.; May 22, 1954.

PHAPITRERON LEUCOTIS ALBIFRONS McGregor.

Phapitreron albifrons MCGREGOR, Philip. Jour. Sci. §A 2 (1907) 317.

Type.—B. S. 11490 A. Celestino & M. Canton, ♂ ; Tagbilaran, Bohol Is.; May 1, 1906.

Neotype.—P. N. M. 0–5684 ad. D. S. Rabor, ♂ ; Sandayong, Sierra Bullones, Bohol Is.; April 24, 1955.

PHAPITRERON AMETHYSTINA POLILLENSIS Hachisuka.

Phapitreron amethystina polillensis HACHISUKA, Contrib. Bds. Philippines. Suppl. No. 2, Publ. 14 (1930) 145.

Type.—B. S. 7037 R. C. McGregor, et al., ♂ ; Polillo Is., September 19, 1909.

Neotype.—P. N. M. 0–2578 ad. A. P. Castro & P. Añonuevo, ♂ ; Anibawan, Polillo Is.; December 6, 1948.

PHAPITRERON AMETHYSTINA CELESTINOI Manuel.

Phapitreron amethystina celestinoi MANUEL, Philip. Jour. Sci. 59 (1936) 300.

Type.—B. S. 11496 ad. A. Celestino & M. Canton, ♂ ; Sevilla, Bohol Is.; March 21, 1906.

Neotype.—P. N. M. 0–5686 ad. D. S. Rabor, ♂ ; Cantaub, Sierra Bullones, Bohol Is.; April 16, 1955.

PHAPITRERON AMETHYSTINA MINDANAOENSIS Manuel.

Phapitreron amethystina mindanaoensis MANUEL, Philip. Jour. Sci. 59 (1936) 301.

Type.—B. S. 12362 ad. A. Celestino, ♂ ; Butuan, Agusan, Mindanao Is.; September 26, 1907.

Neotype.—P. N. M. 0–429 ad. P. Z. E., ♂ ; Davao, Mindanao Is.; August 16, 1946.

PTILINOPUS LECLANCHERI LONGIALIS (Manuel).

Leucotreron leclancheri longialis MANUEL, Philip. Jour. Sci. 59 (1936) 307.

Type.—B. S. 6402 R. C. McGregor & A. Celestino, ♂ ; Batan Is.; May 31, 1907.

Neotype.—P. N. M. 0–1640 ad. C. G. Manuel & T. Oame, ♂ ; Basco, Batan Is.; March 27, 1948.

DUCULA ÆNEA GLAUCOCAUDA Manuel.

Ducula ænea glaucocauda MANUEL, Philip. Jour. Sci. 60 (1936) 410.

Type.—B. S. 29448 ad. F. S. Rivera, ♂ ; Cotabato, Mindanao Is.; April 11, 1932.

Neotype.—P. N. M. 0–444 ad. M. Celestino, ♂ ; Calian, Davao, Mindanao Is.; January 5, 1947.

MACROPYGIA PHASIANELLA PHÆA McGregor.

Macropygia phæa McGREGOR, Philip. Mus. Bull. 4 (1904) 9.

Type.—P. M. 3933 ad. R. C. McGregor & A. Celestino, ♂ ; Calayan Is.; November 18, 1903.

Neotype.—P. N. M. 0–1652 ad. C. G. Manuel & T. Oane, ♂ ; Itbayat Is.; March 16, 1948.

CACATUA HÆMATUROPYGIA MCGREGORI (Hachisuka).

Kakatoe hæmaturopygia mcgregori HACHISUKA, Contrib. Bds. Philippines. Suppl. No. 2, Publ. 14 (1930) 157.

Type.— B. S., ♂ ; Polillo Is.; September 27, 1909; Obviously by R. C. McGregor, *et al.*

Neotype.—P. N. M. 0–5227 ad. C. G. Manuel & J. Ramos, ♂ ; Anibawan, Polillo Is.; April 8, 1956.

TANYGNATHUS LUCIONENSIS PARAGUENUS Hachisuka.

Tanygnathus lucionensis paraguenus HACHISUKA, Contrib. Bds. Philippines. Suppl. No. 2, Publ. 14 (1930) 160.

Type.—*B. S.*, ♀ ; Puerto Princesa, Palawan Is.; December 14, 1905; Obviously by A. Celestino & M. Canton.

Neotype.—*P. N. M. 0–947 ad. Maj. H. T. Wright*, ♀ ; Puerto Princesa, Palawan Is.; March 9, 1947.

TANYGNATHUS SUMATRANUS FREERI McGregor.

Tanygnathus freeri McGREGOR, Philip. Jour. Sci. §D 5 (1910) 108.

Type.—*B. S. 7219 ad. R. C. McGregor & A. Celestino*, ♂ ; Polillo Is.; November 8, 1909.

Cotype.—*B. S. 7175 R. C. McGregor & A. Celestino*, ♀ ; October 21, 1909; Polillo Is.

Neotype.—*P. N. M. 0–2595 ad. A. P. Castro & P. Añonuevo*, ♂ ; Anibawan, Polillo Is.; December 4, 1948.

LORICULUS PHILIPPENSIS BOURNSI McGregor.

Loriculus bournsi McGREGOR, Bur. Gov't. Lab. Publ. 25 (1905) 16.

Type.—*P. M. 4462 R. C. McGregor, et al*, ♂ ; Sibuyan Is.; June 13, 1904.

Neotype.—*P. N. M. 4651 ad. T. Oane & J. Ramos*, ♂ ; Sibuyan Is.; May 24, 1954.

CENTROPUS UNIRUFUS POLILLENSIS Hachisuka.

Centropus unirufus polillensis HACHISUKA, Contrib. Bds. Philppines. Suppl. No. 2, Publ. 14 (1930) 177.

Type.—*B. S. 7177 R. C. McGregor, et al*, ♂ ; Polillo Is.; October 22, 1909.

Neotype.—*P. N. M. 0–2602 ad. A. P. Castro & P. Añonuevo*, ♂ ; Lukutan, Polillo Is.; December 18, 1948.

CHÆTURA GIGANTEA DUBIA McGregor.

Chætura dubia McGREGOR, Bur. Gov't. Lab. Publ. 34 (1905) 15.

Type.—*P. M. 4717 R. C. McGregor, et al*, ♂ ; Mindoro Is.; March 18, 1905.

Neotype.—*P. N. M. 0–134 ad. P. Z. E.*, ♂ ; Masisiat, Abra, Luzon Is.; May 6, 1946.

OTUS SCOPS ROMBLONIS McGregor.

Otus romblonis McGREGOR, Bur. Gov't. Lab. Publ. 25 (1905) 12.

Type.—*P. M. 4886 ad. R. C. McGregor, et al.*, ♀ ; Romblon Is.; June 2, 1904.

Neotype.—*P. N. M. 0–4833 ad. R. Oane*, ♂ ; Tablas Is.; May 25, 1954.

PENELOPIDES PANINI SUBNIGRA McGregor.

Penelopides subnigra McGregor, Philip. Jour. Sci. §D 5 (1910) 110.

Type.—B. S. 7038 ad. R. C. McGregor & A. Celestino, ♂ ; Near Polillo Is.; September 19, 1909.

Neotype.—P. N. M. 0–2628 ad. A. P. Castro & P. Añonuevo, ♂ ; Lukutan, Polillo Is.; December 13, 1948.

PENELOPIDES PANINI BOHOLENSIS Hachisuka.

Penelopides panini boholensis Hachisuka, Contrib. Bds. Philippines. Suppl. No. 2, Publ. 14 (1930) 168.

Type.—B. S. 5271 R. C. McGregor, et al, ♂ ; Guindulman, Bohol; June 5, 1906.

Neotype.—P. N. M. 0–5106 ad. D. S. Rabor, ♂ ; Sierra Bullones, Bohol Is.; March 31, 1955.

CHRYSOCOLAPTES LUCIDUS GRANDIS Hachisuka.

Chrysocolaptes lucidus grandis Hachisuka, Contrib. Bds. Philippines. Suppl. No. 2, Publ. 14 (1930) 177.

Type.—B. S. 6944 R. C. McGregor & A. Celestino, ♀ ; Polillo Is.; September 4, 1909.

Neotype.—P. N. M. 0–2633 ad. A. P. Castro & P. Añonuevo, ♀ ; Anibawan, Polillo Is.; December 2, 1948.

PERICROCOTUS FLAMMEUS NOVUS McGregor.

Pericrocotus novus McGregor, Philip. Mus. Bull. 3 (1904) 13.

Type.—P. M. 2500 ad. R. C. MacGregor & A. Celestino, ♂ ; Irisan, Benguet; May 7, 1903.

Neotype.—P.N.M. 0–206 ad. P.Z.E., ♂ ; Kainay, Abra, Luzon Is.; May 21, 1946.

EDOLISOMA MORIO ELUSUM McGregor.

Edolisoma elusum McGregor, Bur. Gov't. Lab. Publ. 34 (1905) 19.

Type.—P. M. 5102 ad. R. C. McGregor, et al, ♂ ; Balete, Rio Baco, Mindoro Is.; May 17, 1905.

Cotype.—P. M. 5103 R. C. McGregor, et al, ♀ ; Balete, Rio Baco, Mindoro Is.; May 17, 1905.

Neotype.....P. N. M. 0–5227 ad. C. G. Manuel & J. Ramos, ♂ ; San Jose, Mindoro Is.; June 20, 1953.

COPSYCHUS LUZONIENSIS PARVIMACULATA (McGregor).

Kittacincla parvimaculata McGregor, Philip. Jour. Sci. §D 5 (1910) 112.

Type.—B. S. 7151 ad. R. C. McGregor & A. Celestino, ♂ ; Polillo Is.; October 15, 1909.

Neotype.—P. N. M. 0–2677 ad. A. P. Castro & P. Añonuevo, ♂ ; Anibawan; Polillo Is.; December 4, 1948.

MACRONUS STRIATICEPS BOHOLENSIS Hachisuka.

Macronus striaticeps boholensis HACHISUKA, Contrib. Bds. Philippines. Suppl. No. 2, Publ. 14 (1930) 193.

Type.—B. S. 11317 A. Celestino & M. Canton, Tagbilaran, Bohol Is; April 26, 1906.

Neotype.—P. N. M. 0–5112 ad. D. S. Rabor, ♂ ; Sierra Bullones, Bohol Is.; April 17, 1955.

STACHYRIS NIGROCAPITATA AFFINIS (McGregor).

Zosterornis affinis MCGREGOR, Philip. Jour. Sci. §A 2 (1907) 292.

Type.—B. S. 10260 A. Celestino & M. Canton, ♂ ; Lamao, Bataan, Luzon Is.; December 3, 1904.

Neotype.—P. N. M. 0–5614 ad. T. Oane, ♂ ; Jagusara, Juban, Sorsogon, Luzon Is.; June 15, 1956.

PARUS ELEGANS VISAYANUS (Hachisuka).

Pardaliparus elegans visayanus HACHISUKA, Contrib. Bds. Philippines. Suppl. No. 2, Publ. 14 (1930). 201.

Type.—B. S. 5510 R. C. McGregor, et al, ♂ ; Danao, Cebu Is.; July 30, 1906.

Neotype.—P. N. M. 0–4133 ad. D. S. Rabor, ♂ ; Cuernos de Negros, Luzurriaga, Negros Is.; December 22, 1952.

SITTA FRONTALIS INSIGNIS (Hachisuka).

Callisita frontalis insignis HACHISUKA, Contrib. Bds. Philippines. Suppl. No. 2, Publ. 14 (1930) 202.

Type.—B. S. 12774 A. Celestino, ♂ ; Cadiz, Negros Is.; January 29, 1909.

Neotype.—P. N. M. 0–4134 ad. D. S. Rabor, ♂ ; Cuernos de Negros, Luzurriaga, Negros Is.; December 22, 1952.

ZOSTEROPS JOPONICA BATANIS McGregor.

Zosterops batanis MCGREGOR, Philip. Jour. Sci. §A 2 (1907) 343.

Type.—B. S. 6357 ad. R. C. McGregor & A. Celestino, ♂ ; Batan Is.; May 28, 1907.

Cotype.—B. S. 6390 ad. R. C. McGregor & A. Celestino, ♀ ; Batan Is.; May 30, 1907.

Neotype.—P. N. M. 0–1793 ad. C. G. Manuel & T. Oane, ♀ ; Batan Is.; March 20, 1948.

ZOSTEROPS PALPEBROSA BOHOLENSIS McGregor.

Zosterops boholensis MCGREGOR, Philip. Jour. Sci. §A 2 (1907) 329.

Type.—B. S. 5407 R. C. McGregor, A. Celestino, & M. Canton, ♂ ; Guindulman, Bohol Is.; June 21, 1906.

Neotype.—P. N. M. 0–5124 ad. D. S. Rabor, ♂ ; Sierra Bullones, Bohol Is.; April 6, 1955.

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THE USE OF DUCK'S EGGS IN INFLUENZA VIRUS WORK *

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The July–August, 1954, epidemic of influenza provided an opportunity to begin, although in a small way, work with influenza virus. It was necessary to establish the real etiology of that epidemic within the shortest possible time and with the limited facilities at hand. At that time it was not possible to get an adequate supply of standard white leghorn eggs for virus passage, so duck's eggs, which are always available in abundance, were used.

MANAGEMENT OF EGGS BEFORE INOCULATION

The duck's eggs were freed of mud and dirt and thoroughly dried. The date of first incubation was clearly marked on the shells. They were then incubated in an ordinary bacteriological incubator at a constant temperature of 37°C. They were turned three times a day. To provide humidity during incubation, a petri dish of water was placed in the incubator.

On the 10th-12th day of incubation the eggs were candled with an improvised candler. A 100-watt bulb was attached to a wall socket and enclosed in a conical metal tube (1.5 to 4.5 inches in diameter and about 14 inches long). The small diameter of the tube just fitted the egg. The inside of the tube was painted white. The candler was enclosed in a box painted black with the opening just wide enough for the viewer to transilluminate the eggs with comfort and block all direct light. Infertile eggs and those with dead embryos were discarded. The air space of each egg was delimited and the site, where the injection was to be made below the boundary of the air space and where there were no big blood vessels, was marked with a cross.

* Read before the 48th Annual Meeting of the Philippine Medical Association held at Baguio, April 27 to 30, 1955.

VIRUS PASSAGE

The strains of influenza virus used were Pr_8, Fm_1, and Lee. All were lyophilized in 1951 and were obtained from the U. S. Army Medical Graduate Service School in December, 1952. From the time they were obtained to the time they were used, the ampules containing the strains were kept continuously in the refrigerator.

The lyophilized viruses were rehydrated with 1 cc of distilled water. Dilutions of the virus from 10^{-1} to 10^{-5} in 0.85 per cent saline were prepared in sterile Kahn tubes.

The eggs were swabbed with tincture of merthiolate and alcohol one at a time. Each egg was placed on a holder or stand, a discarded wooden end of a wrapping-paper roll. With an ordinary small ampule file, a sort of triangular window(2) was made at the air-space end, and another at the site previously marked with a cross. Both windows were made without piercing the shell membrane. With a small hypodermic needle, the shell membrane at the air-space end window was pierced. Inoculations were made using a tuberculin syringe with a g. 22 needle and starting from the highest dilution. The needle was inserted a few millimeters and 0.2 cc of inoculum was injected. The two openings were dabbed with melted paraffin. Another method of inoculation used was by just utilizing the air-space end opening using a 1.5-inch g. 22 needle, and inserting practically the whole length of the needle obliquely towards the worker.

Placing them along their sides with the site of inoculation on top, the eggs were incubated for 48 hours. They were not turned during this period. At the end of 48 hours the eggs were candled. Only those with live embryos were placed overnight in cold storage.

HARVESTING OF ALLANTOIC FLUID

The next morning the eggs were placed in a pan of ice and were harvested one by one. After swabbing the eggs with tincture of merthiolate and alcohol, they were held slightly tilted from their horizontal position. The shell of each egg covering the whole air-space end was gently removed with the tip of a small mosquito forceps inserted in the uppermost window. With a tooth forceps the shell membrane was pulled to one side and the chorioallantoic membrane was exposed. This was held with the forceps and gently pierced with a

capillary pipette to which a rubber teat was attached. The clear allantoic fluid was pipetted off by gentle suction. A portion of each fluid was tested for sterility. The bottles of harvested fluids were properly labelled.

TITRATION

Each of these harvested fluids was titrated.(4) Dilutions from 1:2 to 1:1024 in 0.85 per cent saline of 0.5 cc volume were made and 0.25 cc of 1 per cent chicken red-cell suspension was added. Readings were made at the end of 2 hours. The highest dilution showing definite agglutination was considered the end point.

AGGLUTINATION-INHIBITION TEST (1), (3)

The paired sera were inactivated at 56°C for 30 minutes. Twofold dilutions in 0.25 cc volume in 0.85 per cent saline of the serum were made from 1:8 to 1:4096. To all the tubes were added 0.25 cc of allantoic fluid of the different strains with 4 units of the virus and 0.25 cc of 1 per cent chicken red-cell suspension. Records were made at 45 minutes and at the end of two hours. The titer of each serum was recorded as the highest dilution which inhibited agglutination.

RESULTS

Serum	Strain	Titer
1a	Fm_1	1:16
	Lee	1:16
1b	Fm_2	1:128
	Lee	1:16
2a	Fm_1	1:32
	Lee	1:32
2b	Fm_1	1:128
	Lee	1:32
3a	Fm_1	1:8
	Lee	1:32
3b	Fm_1	1:64
	Lee	1:32
4a	Fm_1	1:64
	Lee	1:16
4b	Fm_1	1:256
	Lee	1:16
5a	Fm_1	1:32
	Lee	1:8
5b	Fm_1	1:128
	Lee	1:16

RESULTS—Continued

Serum	Strain	Titer
6a	Fm_1	1:32
	Lee	1:32
6b	Fm_1	1:256
	Lee	1:16
7a	Fm_1	1:64
	Lee	1:16
7b	Fm_1	1:1024
	Lee	1:16

DISCUSSION

From the start of this work to the time of writing we have used only duck's eggs, from which we made 118 harvests. We did not find the dark and thick shell of duck's eggs, as compared to white leghorn eggs, a handicap in candling, with the use of proper illumination. The breakage of shells during preparation for inoculation was almost nil because of the thick and tough shell of duck's eggs. Another distinct advantage of duck's eggs is the larger volume of allantoic fluid harvestable. In the Alabang Laboratories where this work is being performed, duck's eggs are plentiful and obtainable cheaply.

We have found that 10 and 11-day-old eggs gave the best results. Older eggs usually have turbid allantoic fluid and at times even stringy deposits of precipitated urates.

Only Fm_1 and Lee strains survived the storage. We passed the Pr_8 blindly four times, but failed. In September, 1955, we received from Col. H. J. Baker of the 406th Medical General Laboratory, Tokyo, a new seed of Pr_8 which we were able to pass regularly.

As shown by our results, only 7 paired samples were tested to determine the etiology of the epidemic. This was so because all the sera were obtained from the employees of the Alabang Serum and Vaccine Laboratories who were sick at the time. They served as an ideal group for study, because of their cooperativeness in submitting convalescent sera. The patients confined in the influenza ward of the San Lazaro Hospital did not do as good. At the time of the epidemic, although there were many patients admitted, it was not possible to get their convalescent sera, since they stayed in the hospital for a week at most.

We were forced to proceed with this work even in the absence of specific antisera as control for the test, because of the urgent need for an etiological diagnosis at the time.

Because we believed more or less in the specificity of the strains and the definite rise in titer for the Fm_1 strain of all the sera tested, we concluded that Fm_1 was the causative strain of the July–August epidemic. This was later confirmed by the findings of the Clark Field Laboratory which it released to the press through the Manila Health Department. The same sera were tested against Pr_8 which arrived in 1955; no definite rise in titer was obtained.

Lately, we have attempted to freeze-dry our harvested fluids. The rehydrated material can be used in the agglutination-inhibition test and as seed for egg inoculation.

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STUDIES OF THE USE OF INTERWOVEN THIN BAMBOO STRIPS AS STRESS-SKIN COVERING FOR AIRCRAFT

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TWO PLATES AND TWO TEXT FIGURES

Aircraft construction in the Philippines is relatively of recent vintage. The initative of undertaking research in this field goes to the Institute of Science and Technology and dates from the time it organized its Aircraft Research and Development Unit toward the end of 1951. Under Section 17(*e*) of Executive Order No. 94, dated October 4, 1947, the Institute is charged with the duty of conducting research and experimentation regarding the possibility of aircraft construction and the use of Philippine materials in such construction.

As an industry, aircraft construction is composed of many subindustries such as production of aircraft engines, accessories, instruments, and special material and equipment required for their manufacture.

In carrying out the mandate imposed upon it by law, the Institute of Science and Technology undertook to deal first with the study and use of local substitutes for such materials as are required for structural airframe construction and the actual testing of the prototype aircraft made from such materials. To equip its experimental models it had to depend on other government or private entities for the necessary materials, help coming principally from the Philippine Air Force which offered both its technical services and facilities at the start of work in January, 1952.

For a small country like the Philippines which has no metal industry and which has a rather limited economy, the all-wood-plywood type or aircraft-airframe construction would be most appropriate. This type is commonly found in many small countries, especially those in Europe. Even during the second World War when there was a scarcity of metals, heavy aircraft with wood used as the principal material for airframe such as the Mosquito and Lancaster type bombers, were mass-produced with great success.

Altho the Philippines has an abundant supply of good-quality wood suitable for airframe construction, difficulties lie in getting the right kind of plywood for the stress-skin covering of the frame. At the time the Institute started its aircraft research, no plywood of aircraft grade that could be used immediately for its purpose was available on the local market. This lack may be ascribed to the following reasons:

1. Most local plywood manufacturers are reluctant to manufacture the thin type of plywood suitable for aircraft construction probably in view of the high cost of putting up the necessary machinery and the lack of sufficient demand for the product.

2. The technique of making thin three-ply aircraft plywood of 1-mm, 1.5-mm, and 3-mm thickness is not yet sufficiently perfected and manufacturers fear that in the absence of the right technique not only the quality of the product would be below par but its cost of production would be relatively high.

3. The glue used in the gluing process is felt to be below the standard aircraft specifications in quality and its use for plywood manufacture for aircraft construction would be risky.

In the face of the lack of the proper plywood which it could use, the Institute undertook a survey of local materials which would possess the desired workability and strength characteristics, would be more readily obtainable than plywood, and would serve as a substitute for the same. As a result of this survey, it came upon the local bamboo the use of which has apparently been overlooked, and of which there is a most abundant supply.

PREPARATION OF BAMBOO

Bamboo is well known for its elasticity. The ratio of its bending strength to its weight is higher than those of woods most commonly used for aircraft. It also compares well with those of chrom-molybdenum steel and aluminum alloy, two standard materials used for highly-stressed parts in metal-aircraft construction. Under bending, tension or compression, bamboo in tubular form can take quite a tremendous load.

In the utilization of bamboo as covering material for airplanes, the first problem encountered was in its preparation into a form flexible enough to be worked and molded into the shape of the outer airframe covering. This problem was met by adopting the woven bamboo mat locally known as *sawale*, the process of producing which is described herein.

Long, thin-walled, straight bamboo stems with long internodes are obtained, preferably during the dry season (sometimes between December and May) and allowed to season. Seasoning prevents shrinkage and easy attack of insects in the finished product.

As soon as properly seasoned, the bamboo culms are split radially. The pieces thus obtained are sliced tangentially to get strips of the desired length for weaving into a coarse mat locally known as *sawale*. For this purpose only the middle layer is used for obtaining the strips. The slippery outer covering and the pulpy inner core are both stripped off and discarded, as these layers both have poor strength qualities, and the glossiness of the outer layer impedes the adhering of the bamboo strips to each other or to the wood base when the mat is made.

The mat may be woven, using any one of the local methods used in the manufacture of hats, baskets, chairs, and other woven products. However, the method best adapted for use in aircraft construction is the one in which the strips are woven diagonally, i.e. at an angle of 45° with respect to the horizontal axis of the airplane. This method saves much material from being clipped off the panels, besides being best adapted to take shear stresses on the skin covering. Any length of mat can be woven with an average width of fifty centimeters, so that as few joints as possible are required in the final assembly on the airplane frame.

Almost any variety of bamboo could supply the strips to be woven into the basic mat. The two species which supplied the strips for the mats used in the research aircraft are the spiny bamboo (*Bambusa spinosa* Roxb.) commonly known as *kawayan* and *kawayan-kiling* (*Bambusa vulgaris* Schrad.), the most abundant and widely distributed in the Philippines. In order to compare as many varieties as possible, samples of several mats of about 1 x 1 meter size and made following our specifications were obtained from several places in the Philippines. The following gives the sources of the mats and the remarks on each sample received:

Source	Remarks
1. Bocaue, Bulacan	Rough work with weave too loose. Easily attacked by *bok-bok*, and rather expensive.

Source	Remarks
2. Taal, Batangas	Uneven strips with pithy portion often included. Some smooth, thin panels eventually used for control surface nose portion.
3. Laoag, Ilocos Norte	Strips too narrow and thick, making it too stiff to work.
4. Danao, Cebu	Even work with fairly smooth weave. Relatively cheaper than the others. It came closest to our specifications.

The mat samples from Danao, Cebu, proved to be the best of all samples received, and that place eventually became the sole source of the bamboo mats used in the research. The mats came in 2 x 0.5 meter sizes with the strips woven at an angle of 45 degrees. Each strips used averaged about 1 cm in width with the thickness ranging from 0.8 to 2 mm depending on the panel qualities and the strength characteristics required.

In actual aircraft construction, before utilizing the mats they were given a protective treatment against borers and weevils (*bok-bok*) by pickling in a briny bath. The mats were immersed in the bath for a period of from 48 to 60 hours, depending on the texture of the strips and the size of the mats. They were then rinsed in clear water and allowed to dry.

DESIGN CHARACTERISTICS

Whether in the single or double ply form, the bamboo mat can readily be used for cantilever, and stressed-skin construction for all types of light aircraft adapted to wood-plywood frame construction. As an aircraft material substitute for plywood, it could be extensively used for skin covering of wings, fuselages, and control surfaces. In the first L–14 MAYA research light aircraft, the woven-bamboo material was distributed as follows:

1. As over-all covering for the whole fuselage with the panels applied on the wood framework by simply gluing and nailing. Single-ply mat was used throughout.
2. On the nose portion of control surfaces to take torsional stress loads.

In the subsequent research aircraft model, the L–15 TAGAK ambulance and utility aircraft, the mat was used in the following:

1. As covering of one-half of the tail booms.
2. As covering of the nose portion of all control surfaces.

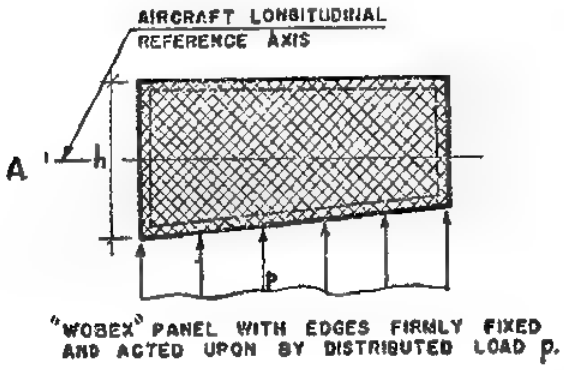
3. As partial covering of the fuselage.
4. As stiffness covering for the wing-nose portion.

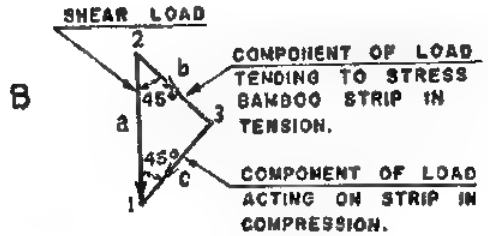
The lay-out of the bamboo-strip structure follows somewhat the principle of the so-called "geodetic" construction of aircraft bodies, which has been extensively used on the continent for dirigibles and for air-frame construction by Vickers-Wallis. The airframe is constructed with metal strips or stringers drawn spirally around the fuselage from one end to the other. One band goes right and the other, left at 90 degrees, so that the whole system forms a stiff metal network that needs no further inner reinforcements, such as struts, tie-roads or bulkheads. On the same principle, the bamboo strips form a tight outside covering, although it is not stressed to take up bending, so that it still requires the bulkheads-and-stringers framework. Normal shear and torsional stresses are taken by the woven-bamboo covering. These shear loads are transformed to act as tension and compression loads on the individual bamboo strips, as shown in Fig. 1.

Generally, when a flat sheet panel is subjected to shear loads, the effect of the shear stress applies tension along one diagonal of the panel and compression along the other as indicated in the figure. The stresses in the compression direction cause the sheet to tend to deflect laterally, and, if the stresses are high enough, wrinkles or buckles form along the diagonal lines. The direction of the wrinkles would be normal to the direction of the compression component of the stress in the panel, or at about 45° to the direction of the shear load. It must be noted that thin panels are always critical to buckling due to compression.

As can be observed from the figure, the bamboo strip, which normally acts as single column length, is transformed into several short columns under compression due to the restraining action of the opposite diagonally-woven strips under tension load. This has the direct effect of reducing the slenderness ratio of the original columns, thus directly increasing the value of the critical buckling load on the member under compression. The diagonal strips set at 45° are fully effective under tension load, and bamboo has a relatively high tensile strength.

Under the conditions listed above, the maximum allowable stress for the strip elements assumed to act under compression along the direction 3–1 may be determined by applying the





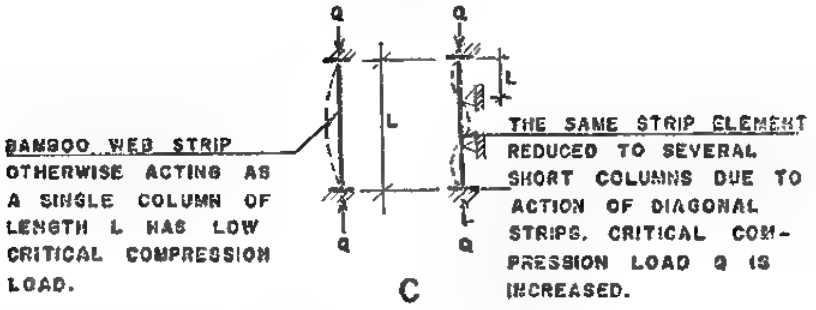


Fig. 1. Effect of interweaving bamboo strips on the diagonal compression length.

ANC–18 Forest Laboratory Product Equation (4) for short columns, which is:

$$\sigma_c = \sigma_{cu}\left[1 - \frac{1}{3}\left(\frac{L'}{K\rho}\right)^4\right]$$

Where:

σ_c = compression stress developed along the diagonal strips.

σ_{cu} = ultimate compressive stress parallel to the grain for bamboo with nodes.

$L' = \frac{L}{\sqrt{C}}$ where C is the fixity factor and can be equal to 1.5.

$K = \left[\frac{L'}{\rho}\right]_{cr}$ an empirical constant with ρ as the radius of gyration.

All design stresses affecting the bamboo skin covering for the L–14 MAYA aircraft, whether under single normal shear or under combined stresses, were based on loading conditions as specified in the Civil Air Regulations, Part 3, for airplane airworthiness under the utility category.

Comparison between the calculated material properties by the methods given above and the allowable stresses obtained by actual static tests gave much higher strength values for the test method. This could be accounted for by the fact that the strips are more or less restrained throughout their whole length by the glue and filler applied.

Small panels with rigid frames may be treated as Wagner beams. By assuming that the web buckles immediately upon the application of the shear load and that the only stresses resisting the shear forces are the tensile stresses acting along the 45° diagonal tension strips (Fig. 2), and considering the infinitely rigid

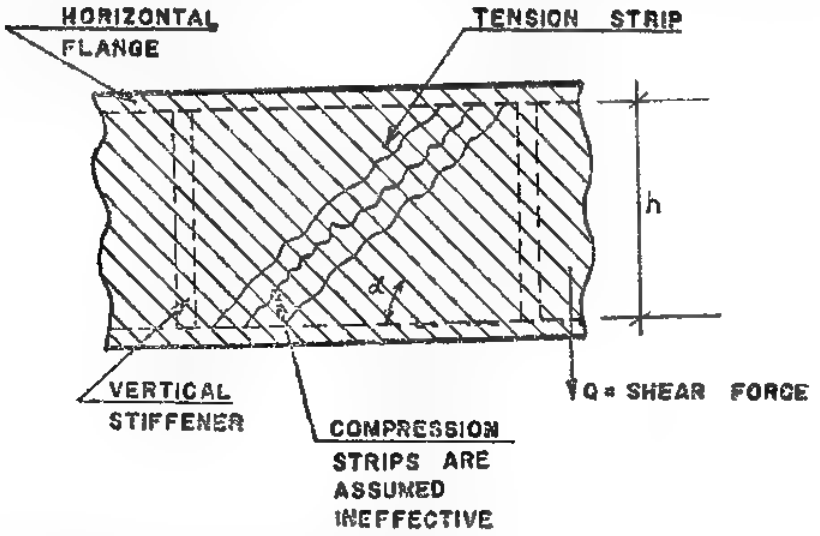


FIG. 2. "Wobex" panel treated as a Wagner beam.

frames with parallel span flanges and vertical stiffeners, the following equation may be applied.

$$\sigma_T = \frac{2\,Q}{h\,t} \cdot \frac{1}{\sin 2\,\alpha}$$

Where:

σ_T = diagonal tension stress in the strips.
Q = applied shear load.
t = web thickness.
h = effective web height.
α = angle between diagonal strip and reference axis.

PROPERTIES

Strength characteristcs of woven-strip matting used in the L–14 aircraft construction:

Average strip dimension:	
Thickness	0.6 to 1.2 mm.
Width	12.0 to 18.0 mm.
Length of nodes	35.0 to 45.0 cm.
Specific weight	0.6 to 0.8 g/cm.^{3}
Moisture content	12.0 to 15.0 per cent
Panel weights:	
Plain woven panel	1.2 to 1.3 kg/sq. m.
Treated with filler and finishing	1.55 to 1.75 kg/sq. m.
With fabric cover and finishing	1.7 to 1.95 kg/sq. m.
Tensile strength of strips:	
Maximum (plain)	1830 kg/cm^2
Average with nodes (selected)	1330 kg/cm^2
Minimum with nodes (assorted)	635 kg/cm^2
Shear strength of mat panels:	
Strips set at 90°	110 kg/cm^2
Strips set at 45°	245 kg/cm^2
Bending strength of strips:	
Maximum	1500 kg/cm^2
Average with nodes	850 kg/cm^2
Compression strength of strips:	
Average	365 kg/cm^2
Minimum	250 kg/cm^2
Modulus of elasticity	2×10^5 to 3×10^5 kg/cm^2
Glue shear strength of bamboo to wood:	
Dry, Maximum	40 kg/cm^2
Dry, Average	35 kg/cm^2
Dry, Minimum	26 kg/cm^2
Wet Average	20 to 22 kg/cm^2
Glue shear strength of bamboo to bamboo (parallel grains):	
Dry, Maximum	48 kg/cm^2
Dry, Average	39.5 kg/cm^2
Wet	27 to 30 kg/cm^2
Workability	good
Availability	almost unlimited
Price	P1.00 to 1.50/sq. m.

APPLICATION

The woven-strip matting was first used on the L–14 MAYA research aircraft of the Institute of Science and Technology. The whole fuselage of this aircraft was covered with a single layer of the mat. In the preparation of the bamboo panels, the mat was laid flat on a smooth surface, and the weave of the mat tightened. A thick metal plate was set over the mat and the plate piled with heavy iron weights. This was to take the place of a press, which the Institute did not have. Although the pressing did not turn out as effective as desired, it gave the woven-strip matting an initial smoothness.

To prevent the mat edges from prying open, a coat of thin glue was brushed on the portion that was to be sheared or cut later. The mat was cut into appropriate panel sizes with the help of prepared patterns, and set onto the wood structure of the airframe. Application was effected by gluing and nailing. The panels were joined by simple overlapping joints. With the panels in position, the surface was given an over-all coat of thin glue applied by brush on the outer surface and thin enough to penetrate well into the weave. This was necessary to improve the stiffness of the material and prevent the strips from sliding past each other when acted upon by loads during flight.

To smoothen the rough outer surface, a wet mixture of fine sawdust (preferably from soft wood) and glue was applied as a putty to fill in the crevices and unevennesses of the bamboo surface. This application has the advantage of making the surface leak-proof. After sanding and proper smoothening, the surface was ready for the usual aircraft specification finishing, which consists of the application of three coats of aircraft clear, cellulose nitrate dope by brush and light sanding after the third coat. This was followed by three more coats of aluminum-pigmented dope for the final finish. The inside surface of the bamboo mat was finished with two coasts of wood varnish.

The finish of the outer bamboo-mat surface may be improved by the application of a thin fabric covering. This was tried with the horizontal tail surface and the nose portion of the control surfaces. This process eliminates the need of using putty, besides providing better protection of the outer surface from weather conditions. The increase in weight due to this application is negligible.

In general two or more layers of the woven bamboo mat can be pressed or laminated together with the application of a suitable glue. The glue used in the aircraft was a commercially-available water-resistant plastic resin glue known as "Weldwood." It gives the material a plywood character with excellent strength and finish characteristics. Regardless of the number of layers, the mat can always be worked to any size or shape, especially as an outer stress-skin covering, for webbing, and reinforcements in aircraft construction. It can be shaped and bent easily by steaming the material or by using the simple wet techniques.

The maximum size of bamboo-mat panels used in the L–14 research aircraft was about 25 x 50 cm. The average rectangular panel was 18 x 40 cm.

TABLE 1.—*Average bending strength to weight ratios of several commonly-used materials for aircraft construction and bamboo strips.*

Material	g/cm³	Kg/cm²	cm⁻¹×10³
17 ST aluminum alloy	2.78	3,880	1,395
24 ST aluminum alloy	2.78	4,550	1,565
1025 carbon steel	7.87	3,860	493
X–4130 chrom-moly steel	7.87	6,700	852
18–8 stainless steel	7.87	6,480	823
Spruce	0.40	670	1,680
Birch	0.60	820	1,370
Douglas fir	0.51	8.0	1,590
Bamboo strips	0.65	1,250	1 925

CONCLUSIONS AND REMARKS

WOBEX (woven bamboo experimental) is the name given to the bamboo matting or *sawale* used in this report. Studies and observations on the product have shown that Wobex is a good substitute material as stiffening for the nose portion of control surface and for the wings of aircraft. In the single-ply form, it has the advantage of being easily workable, light, economical, and durable. Being derived from a tropical plant, it is probably best adapted for local climatic conditions. Tests on the XL–14 especially during the functional stage, when the aircraft was purposely exposed to severe weather conditions for more than four weeks during the rainy season, did not show adverse effects on the material. Neither have traces of deterioration or *bok-bok* attack been noticed for the last three years since its construction. At one time, during the taxiing and take-off tests of the aircraft, it was accidentally dropped from

a height of about ten feet to the ground. The aircraft did not experienced any structural failure except on the landing-gear system. This was easily remedied. The pilot claimed that it had good damping characteristics for shock loads as well as good sound-absorption qualities.

Wobex is relatively strong and its fatigue strength under bending stress is much higher than that of wood. Its non-magnetic qualities may make it useful for aircraft for special purposes. It is definitely non-corrosive, and therefore an ideal construction material for sea-plane floats and flying boat hulls.

The supply of bamboo is practically unlimited and there are other fields for its development and use. For example, studies have been started on the possibility of adopting a form of laminated bamboo strip of sufficient size for use as the landing leg of light aircraft. The good bending characteristics of bamboo would enable it to serve as the spring to absorb landing shock loads. This would eliminate the necessity of using separate shock-absorbing accessories in the landing gear system. In the Cessna Aircraft, there is no landing gear aside from the cantilever spring-type landing leg.

In spite of the limited facilities at the disposal of the Institute of Science and Technology, studies to find ways of improving the product are being continued. One main contention of the common observer is that the aircraft is a fire hazard. An aircraft's likelihood of burning is primarily dependent on its design, as showed by the fact that even metal aircraft burns. There is also, of course, the common prejudiced notion that, being a local product and not "imported," Wobex-containing planes must necessarily be inferior in quality. This attitude, however, could probably be overcome in time by the encouragement of those directly interested in its use.

The basic bamboo-mat material manufacture has been a kind of home industry in the island for centuries. The production is quick and relatively cheap; no elaborate or costly machinery or special skills are required. Hence, for light aircraft for local use, it could be a good source of construction material.

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ILLUSTRATIONS

PLATE 1

FIG. 1. The L–14-experimental aircraft fuselage during the process of covering with "Wobex" panels. The fuselage framework consists of wood bull-heads and stringers.

2. The aircraft body completed with the reinforced bamboo-mat covering used to take up shear and compression stresses.

PLATE 2

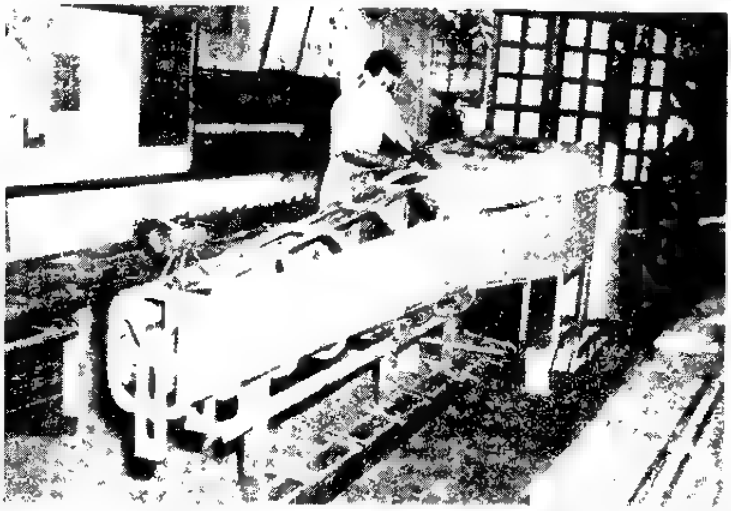
FIG. 3. The XL–14 "Maya" experimental aircraft during a functional test flight. Its gross weight is 780 kg. It is powered by a 100 HP Lycoming engine. It has a wing loading of 48.75 kg/M^2 and flies at 115 MPH maximum level speed.

4. The XL–15 utility and ambulance aircraft showing finished fuselage and tail booms. The airframe was partially covered with "Wobex" panels.

TEXT FIGURES

FIG. 1. Effect of interweaving bamboo strips on the diagonal compression length.

2. "Wobex" panel treated as a Wagner beam.



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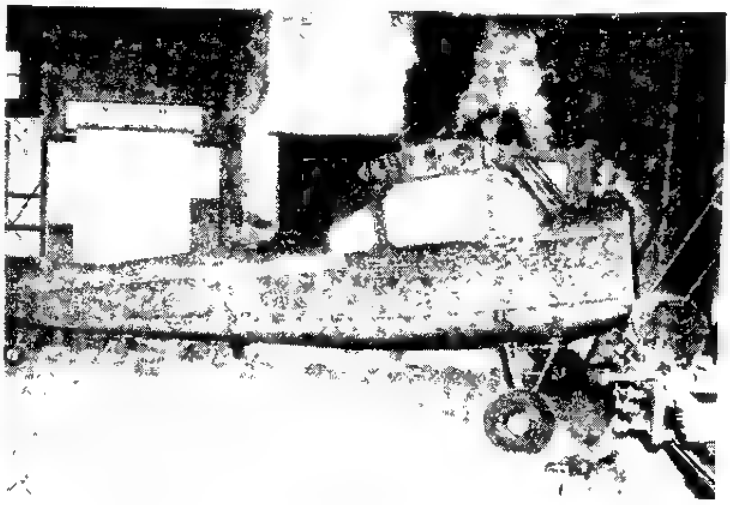

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PLATE 1.

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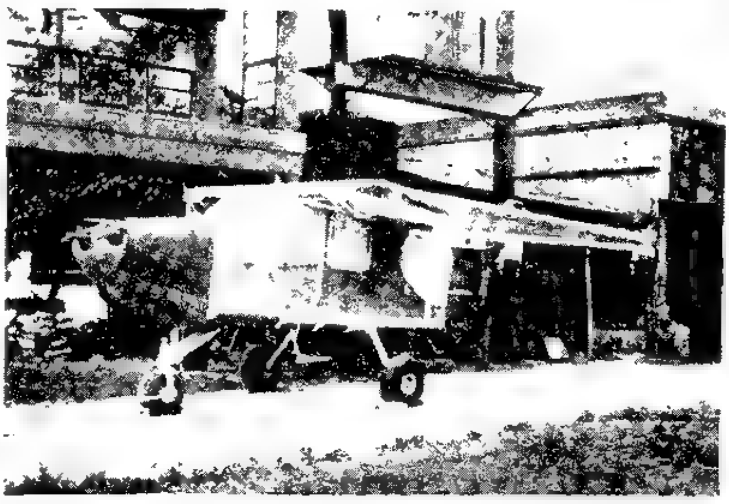

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PLATE 2.

NOTES ON CAMOTE RITUALS IN LEYTE AND SAMAR ISLANDS, PHILIPPINES

By Richard Arens, S.V.D.
Saint Paul's College, Tacloban, Leyte

TWO PLATES

The people of Leyte and Samar have a variety of staple food. Rice is the "queen" and has to be served at every gala occasion; it is also an ordinary food item on the table of the poor. The camote or sweet potato is a "commoner" and the host offering a dish of camote will excuse himself. Nevertheless it is a tasty dish and is very much liked by the children.

In mountain places—especially in Samar where rice does not grow well—camote becomes the staple food. It is in Samar where the greatest variety and best quality of camote has been produced. The main varieties of camote in Samar are: Karingkit, Samar yellow, Kinampay, Kasandig, Martisana, Kasapad, Tab-angan, Binasaynon, Kubulad, Katimpa, Kinatursi, Karausi, Sinintabo, and Kasidoy. In 1955, Samar planted 7,075 hectares of camote with a yield of 247,428 tons.[1]

According to some historians the sweet potato (or camote) was brought from the Americas to this part of the Pacific. A comparison of the ritual of planting and harvesting rice with the camote ritual leads to the assumption that rice arrived in the Philippines earlier, because the camote ritual seems to be more or less an imitation of the rice ritual. The evidence, however, is not conclusive.

Preparing the field.—Before planting, the field is carefully cleared. Care is taken that no roots of plants grown there before remain, since they would hinder the growth of the camote. Furrows called *tudling* are prepared. The camote cuttings are imbedded in cone-shaped hills or in holes (*bobon*), spaced about a meter apart lengthwise and crosswise. Three cuttings per hill or hole are planted at points 1, 2, and 3 in the diagram: $_{1}\overset{3}{\underset{|}{\text{—}}}\text{—}_{2}$. In this way, cuttings are given the best chance to develop plenty of roots, which are essential for a good yield. The cuttings are taken from an already

[1] Office of the Provincial Treasurer, Catbalogan, Samar.

harvested old camote field, because cuttings of a non-harvested field are regarded as barren.

Time of planting.—The right time of planting is important to the farmer to have a good harvest. Full moon[2] is considered the best time. It is the belief that planting at full moon will give the camote a round, smooth form. The presence of a group of clouds is highly desired by the Tacloban farmer. The symbolism is the same as that of the full moon. On the night before planting, the farmer watches the sky to make sure that the "Great Dipper" (*Ursa major*), a group of stars arranged in the form of a dipper, is just overhead, so that the roots of the camote will be joined together as closely as the stars.[3]

Planting has to be done at low tide,[4] when plenty of big stones are seen in the sea, the swamps, and rivers, because this means that the camote will be as big and numerous as the heavy stones seen in those places.

Planting ceremony.—After the right time for planting has been computed, the farmer—often an older woman—goes with two children to the prepared field. In La Paz (Central Leyte) this is done at about five or six o'clock in the evening, when the sun begins to set, and no birds are seen flying above the *tudling*. The woman squats in one of the squares of the lot and prays to God to give a good and fruitful harvest. With her are two children which, during the first planting, are carried piggy-back; this symbolizes that the roots of the camote will go deep. She brings along a human hair, because the hair symbolizes roots, and the more roots a camote plant develops the better. She carries also a stone signifying the expected weight of the camote. Another symbolic meaning of the stone is to make the roots resist heavy rain and corruption; or to resist the attack of insects on the roots and vines of the camote plant during a long season. Once infested by insects, the yield of the crop is small. In other places[5] sugar and money are added during the planting ceremony to make the camote sweet and tasty. A spoonful of sand is placed around the base of the first plant to make the camote as numerous as the sand grains.

[2] Practice in Tanauan, Alangalang, Carigara, Tacloban.
[3] Practice in Tacloban, Carigara.
[4] Contrary to the custom in the rice ritual, where planting and harvesting is begun at high tide.
[5] Tacloban, Burauen, Dulag.

The farmers of Barugo do not permit thin and weak people to plant camote; instead they prefer stout persons and pregnant women. The custom of piggy-back riding in the planting ceremony is known throughout Leyte and Samar, along with the other symbols so far described.

In one barrio of Tacloban—San Jose—the unique practice of stripping before the first planting is widespread. It is the belief that planting in the nude makes the skin of the camote thin. In addition, the planters put babies on their backs in the hope that the camote will grow tubers in bunches. Since the camote has many colors, like yellow, violet, orange, and white, the babies are dressed in the color that one wishes the camote to be. At the actual planting, the dresses are taken off from the babies and placed near a *bobon*. This practice, however, is not common throughout the barrios of Tacloban; it is the exception, and the writer could not find any other place in Leyte and Samar where it prevails.

In Carigara, instead of children, an old man rides on the back of the man who does the first planting. Both of them cross their fingers, hoping that the tubers will overlap in the same way.

In Catarman (northwest of Samar), to the symbols already mentioned in camote planting, a carabao horn and cat's paw are added. Both are hung in the extreme corner of the field for protection against wild animals and rats.

In Dulag, after the planting has been done, the planters are prohibited to touch things having fibers; for example, rope. It is the belief that the camote would become fibrous and therefore be less useful for consumption. All this symbolism is rather simple. The rice ritual in Leyte and Samar is by far more manifold and rich.

Harvesting camote.—When the crop is ready for harvest, which may be in three to five months depending on the kind of camote planted, a woman or two go to the plantation[6] bringing along sugar, ashes from the stove, and a coconut. She digs out one big tuber and holds it in one hand; in the other hand she holds the ashes and says, "May the roots be so big that they will crack as the ashes do."

The camote is cut and sugar is applied, then, tasting it, one says, "May the crop be as sweet as this sugar." There-

[6] Practice in La Paz. In some places, care is taken that the same person who did the first planting does the first harvesting.

after, adding grated coconut he says, "May the roots be as palatable as the coconut meat." When this is done, enough camote are harvested for one cooking. Attempts are made to harvest the biggest camote. When the harvester arrives home, she takes one big camote and strikes it against the stove and a stone. This cracked camote is served. All those eating say first, "Hmmmm, how sweet—it is like sugar." Not all of the camote is eaten. Something is preserved for the second harvest the next day. During the second harvest there is no limitation to the number of camote harvested. Some are cooked and served together with the left-overs of the first harvest the day before, in the belief that the family will have an abundant harvest and that they will not be able to consume it all until the next harvest. In Dulag the first camote is cooked in a cracked or leaking pot—without water—so as to retain the camote's flavor. Prayers are said after the meal of the first harvest. Thanks is given to God and Saint Isidro, the patron of farmers, for the rich harvest.

The ritual of camote planting and harvesting is less diversified than that of rice. The uniformity and simplicity of the ritual tend to show that camote was introduced into the Philippines later than rice.

ILLUSTRATIONS

PLATE 1

FIG. 1. Woman carrying in her hands sugar-cane and a stone at the start of the camote ritual. She prays: God make the camote as sweet as the sugar-cane and as heavy as the stone. Children carry the camote cuttings.

2. Woman in planting first camote, squats before the hole (bobon); in her left hand the camote cuttings for planting is in cross form; in her right hand is the symbolic stone to make the camote heavy.

PLATE 2

FIG. 3. Camote harvesting. Harvested camote is held in left hand, dry ashes in the right. Harvester says: May the roots be so big that they will crack as the ashes do.

4. Woman strikes a harvested camote against a stove and a stone. Cracked camote is cooked and served.

1

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PLATE 1.

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PLATE 1.

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PLATE 2.

RECORDS AND DESCRIPTIONS OF JAPANESE TIPULIDÆ (DIPTERA), PART V

THE CRANE-FLIES OF HONSHU, I

By Charles P. Alexander
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FOUR PLATES AND TWO TEXT FIGURES

INTRODUCTION

The preceding four parts under this general title were devoted to a consideration of the Tipuiidæ of Shikoku, including a total of 263 species. It is certain that many further species will be added to the Shikoku list as a result of future collecting.

At the present time it appears advisable to begin the listing of these flies as known from Honshu, the main island of Japan. As was indicated in the initial paper under this title,[1] it is planned to number the species for each of the main islands consecutively throughout the parts that are devoted to them, so the total number recorded for any individual island in this series of reports may be known at any time. However, it seems advisable to provide a record of the total number of species considered in the entire series of reports and such consecutive totals will be provided following each species as added to the list, this figure being placed in parenthesis.

In the initial paper I had discussed briefly the historical development of our knowledge of this subject during the preceding century and had listed many of the entomologists who were active in the collecting and study of these flies during that period. As concerns the island of Honshu, this list of students and collectors is repeated here, with a certain few additions, providing a fairly complete record for the period through 1950.

Esaki, Gallois, Hibi, Hilgendorf, Imanishi, Inoue, Ishimori, Issiki, Ito, Kariya, Kato, Kawase, Kitakami, Kuwana, Kuwa-

[1] Philip. Jour. Sci. 82 (1953) 21–75, *2 pls.*

yama, Machida, Masaki, Matusumura, Monzen, Mutuura, Nakahara, Nohira, Oda, Okada, Saito, Sakaguchi, Sekiya, Shiraki, Suenson, Takahashi, Takeuchi, Tanaka, Teranishi, Tokunaga, Ueno, Yamamoto, and Hadiro Yuasa.

Since 1950 various further students and collectors have added materially to our knowledge of the Tipulidæ of Honshu, these including the following.

Kintaro Baba, George F. Byers, Fukuhara, Toshiro Haruta, H. Hasegawa, Seiji Higuma, Masami Honma, Hiroshi Ishida, Ishizuka, S. Iwano, T. Kodama, Hiroshi Koiike, Takashi Kuwayama, Yoshitomo Maruyama, Akira Nobuchi, Hiroaki Ohira, Yasumasa Omori, S. Sagimoto, Zyûzô Sawano, Hanssen Shenker, Kotaro Shirahata, Marion E. Smith, Takeichi Takei, and Hisao Yamazaki.

Of primary importance are the outstanding series of these flies taken in the provinces of Echigo and Sado by Dr. Kintaro Baba, of Kurokawa, assisted by various friends and colleagues. Most of these specimens were secured by Dr. Baba in the vicinity of Kurokawa in 1954 and 1955, with further interesting materials from Mount Sumon, Echigo, taken in June, 1954, and from Mount Amakazari, Echigo, in June, 1955. An important further series were taken by Dr. Baba on Mount Donden, Sado, in July, 1955. Collectors on behalf of Dr. Baba on the island of Sado include Messrs. Higuma, Honma and Yamazaki, of the preceding list. Other materials were taken by Koiki on Mount Yakamine, in Echigo, and by Ohira on Mount Takamori, likewise in Echigo. Shirahata secured a few specimens on Mount Chokai in Uzen.

Important collections of these flies have been received from Professor Syusiro Ito, taken chiefly by himself on his various trips to many sections of Honshu, in cases being accompanied by Issiki and Mutuura. In June, 1951, together with Issiki, he secured large series of these flies in Ugo province, in northeastern Honshu. Very interesting specimens were taken in the alpine sections of Shinano in August, 1949 and again in May, 1953, with further materials from the same general area secured by Kodama and Sagimoto. Smaller series of these flies were taken by Ito in 1951, 1953, and 1954 in the provinces of Aki, Hoki, Inaba, Kii, Suo, and Tajima.

In addition to these two extensive series of crane-flies, other collections were received from Messrs. Hasegawa, Inoue and Ishizuka, taken in the Japanese Alps, chiefly between 1951

and 1953; from Kawase, taken in Echigo in 1951 and 1952, and from Takei, secured in Kotsuke in 1954 and 1955. Two American colleagues, Dr. George F. Byers and Dr. Marion E. Smith, made collections of these flies in Honshu in 1954. I wish to express my deepest thanks to all of the above listed friends and co-workers for such invaluable aid in the study of the crane-flies of Honshu.

Attention is called to the preparation by Hiroshi Ishida of the first part of a Catalogue of the Japanese Tipulidæ, with keys to the genera and subgenera.[2] This is an outstanding work that will be of great importance in advancing our knowledge of the rich crane-fly fauna of the islands. A further excellent report by Messrs. Tokunaga, Ishida, and Nobuchi concerns the species of crane-flies that cause damage to mushrooms in Japan.[3]

THE ISLAND OF HONSHU

Honshu is the largest of the four major Japanese islands, with a total area of about 86,772 square miles and a coast line of approximately 6,040 miles. The central mountainous area forms almost a square measuring 130 miles across, beginning in the west with the Alps in Etchu, Hida, and Shinano, ending in the east with Mount Fuji. South of this mountainous belt, the chief peaks are Omine (6,169 feet) and Odai-go-hara (5,540 feet), in Yamato, and Daisen (Oyama) in Hoki. The highest peaks, with their location and altitude in feet, are as follows:

Fuji	Suruga-Kai	12,394
Shirane Kitadake	Kai	10,472
Shirane Ainotake	Kai-Suruga	10,462
Yarigatake	Shinano-Hida	10,432
Higashidake	Suruga	10,321
Akaishidake	Shinano-Suruga	10,236
Oku-Hodaka	Shinano-Hida	10,180

[2] Ishida, Hiroshi. The catalogue of the Japanese Tipulidæ, with the keys to the genera and subgenera. I. Tipulinæ (Part). Kenkyu Shuroku (Annual Reports of the Hyogo Agricultural College) 4 (1954) 106–135; issued June 28, 1955.

[3] Tokunaga, M., H. Ishida, and A. Nobuchi. Crane-flies injurious to useful mushrooms in Japan, with revision of the Japanese *Ula* species and descriptions of a known and three new species and immature stages of two species (Tipulidæ, Diptera). Scient. Repts, Saikyo Univ., Agriculture, No. 6 (1954) 1–10, *figs. 1–19.*

Hodaka	Shinano-Hida	10,137
Arakawadake	Suruga	10,114
Ontake	Shinano-Hida	10,047
Shiomidake	Shinano-Suruga	9,996
Kita-Hodaka	Kai	9,950
Senjogadake	Shinano-Kai	9,950
Shirane Nodoridake	Kai-Suruga	9,927
Norikuradake	Shinano-Hida	9,927
Hijiridake	Shinano-Suruga	9,878

The highest peak in the Nikko Mountains is Nantaisan, 8,169 feet. The mountainous center of Honshu leaves narrow coastal plains and relatively short rivers having narrow alluvial valleys. The chief of such rivers are the following:

Flowing to the Japan Sea. Agano (105 miles); Go-no (124); Mogami (134); Jinzu (78); Noshiro (85); Omono (93); Shinano (229). To the Pacific Ocean. Abukuma (122 miles); Ara (110); Kiso (144); Kitakami (152); Naka (78); Shingu (100); Fuji (100); Tenryu (134); Tone (200). To the Inland Sea. Yodo (49 miles).

The largest lake is Biwa-ko (area 674 square kilometers). The more important mountain lakes include Chuzenji in Shimotsuke; Ashi-no-ko, at Hakone; and Suwa-ko in Shinano.

The plains, with their principal cities and their chief rivers are:

Echigo	Niigata	Agano, Shinano Rivers
Kinai	Kobe, Kyoto, Osaka	Yodo River
Kwanto	Tokyo, Yokohama	Ara, Naka, Sagami, Tama, and Tone Rivers
Nobi	Gifu, Nagoya	Kiso system
Sendai	Sendai	Abukuma, Kitakami Rivers

Provinces and Prefectures. Many published records of crane-flies have been reported by Provinces while others are similarly listed by Prefectures and in order to avoid confusion the equivalent names are indicated herewith. Wherever possible records are given in names of Provinces.

Province (Kuni)	Prefecture (Ken)
Aki	Hiroshima
Awa	Chiba
Awaji	Hyogo
Bitchu (Bichiu)	Okayama
Bingo	Hiroshima
Bizen	Okayama
Echigo	Niigata
Etchu (Echiu)	Toyama
Echizen	Fukui

Province (Kuni)	Prefecture (Ken)
Harima	Hyogo
Hida	Gifu
Hitachi	Ibaraki
Hoki	Tottori
Iga	Miye
Inaba	Tottori
Ise	Miye
Iwaki	Fukushima
Iwami	Shimane
Iwashiro	Fukushima
Izu	Shizuoka
Izumi	Osaka
Izumo	Shimane
Kaga	Ishikawa
Kai	Yamanashi
Kawachi	Osaka
Kazusa	Chiba
Kii	Wakayama
Kotsuke	Gumma
Mikawa	Aichi
Mimasaka	Okayama
Mino	Gifu
Musashi	Tokyo, Saitama
Mutsu	Aomori
Nagato	Yamaguchi
Noto	Ishikawa
Oki	Shimane
Omi	Shiga
Owari	Aichi
Rikuchu	Iwate
Rikuzen	Miyagi
Sado	Niigata
Sagami	Kanagawa
Settsu	Osaka
Shima	Miye
Shimosa	Chiba
Shimotsuke	Tochigi
Shinano	Nagano
Suo	Yamaguchi
Suruga	Shizuoka
Tajima	Hyogo
Tanba (Tamba)	Kyoto
Tango	Kyoto
Totomi	Shizuoka
Ugo	Akita
Uzen	Yamagata
Wakasa	Fukui
Yamashiro	Kyoto
Yamato	Nara

The maps showing the provinces of Honshu were prepared for me by Mr. Y. Hirashima, assistant to Dr. Teiso Esaki in the Entomological Laboratory, Kyushu University, Fukuoka. I am deeply indebted to Mr. Hirashima for the extreme care devoted to the preparation of these maps, which will prove to be of great aid in using the present paper and those to follow.

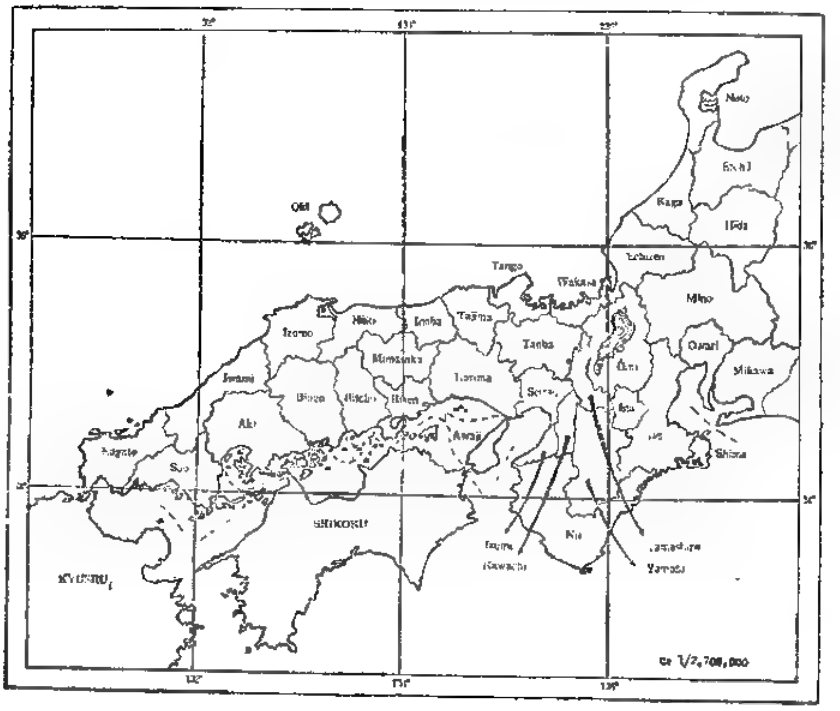


FIG. 1.

RECORDS OF DISTRIBUTION

LIMONIINÆ

PEDICINI

1 (264). PEDICIA (TRICYPHONA) TENUILOBA sp. nov.

Allied to *vetusta;* general coloration of thorax gray, the præscutum with three black stripes; femora yellow, the tips brownish black, broadest on the fore pair where more than the outer third is included; male hypopygium only slightly

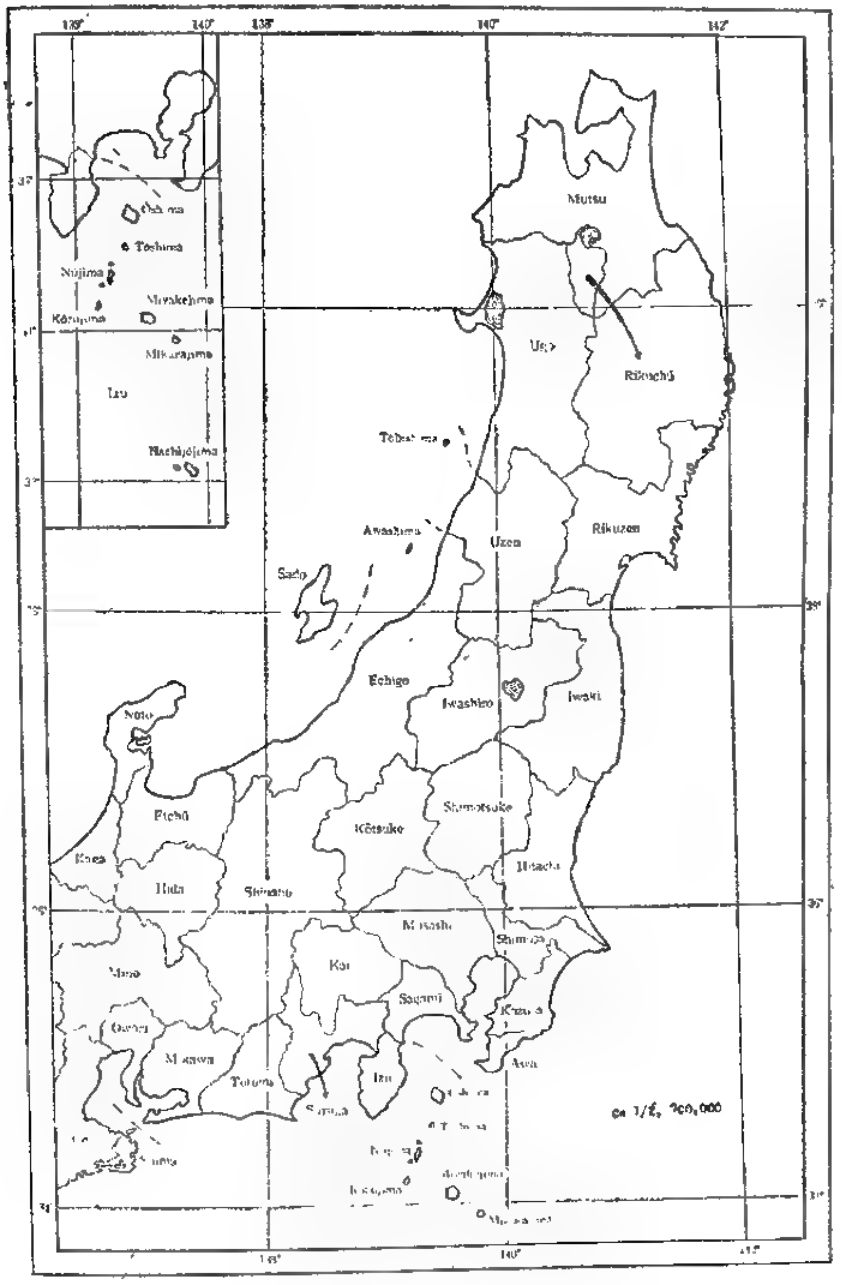

Mutsu
Uzen
Rikuzen
Awashima
Sado
Echigo
Iwashiro
Iwaki
Noto
Kōzuke
Shimotsuke
Hitachi
Musashi
Kai
Sagami
Izu
Awa
Mikura-jima
Hachijō-jima

FIG. 2.

hairy; apical lobe of basistyle long and slender; interbase a sinuous blade, directed caudad, its surface microscopically setulose; dististyle a narrow paddlelike blade.

Male.—Length, about 9 millimeters; wing, 11; antenna, about 1.1.

Rostrum dark gray; palpi black. Antennæ short, black, scape pruinose; flagellar segments oval to long-oval; verticils conspicuous. Head brownish gray, the orbits clearer gray.

Pronotum dark gray. Mesonotal præscutum gray, in male with three black stripes, the central one broad; the allotype female has the central stripe completely divided by a narrow median ground vitta; posterior sclerites of notum gray, scutal lobes slightly darker; postnotum and pleura clear light gray; dorsopleural membrane dark. Halteres with stem dusky, knob infuscated. Legs with the coxæ light gray, the fore pair paler at tips; trochanters brown; femora yellow basally, the tips brownish black, broadest on the fore pair where more than the outer third is included, on the remaining femora much narrower; tibiæ and tarsi brown, the outer tarsal segments brownish black. Wings brownish yellow, the base clearer yellow; a conspicuous brown pattern, arranged as in the *vetusta* group, including areas at Sc_2, origin of Rs, cord, R_{1+2}, m, narrow wing tip, and as small marginal spots at ends of the longitudinal veins, largest but still inconspicuous on 2nd A; veins light brown, darker in the patterned areas, yellow at wing base. Venation: r-m close to fork of Rs, R_{2+3+4} subperpendicular; cell 1st M_2 elongate, basal section of M_3 about one-half longer than the distal section.

Abdomen brownish yellow, the base dark brown; outer segments, including hypopygium, black, gray pruinose. Male hypopygium (Plate 1, fig. 2) with the tergite large, narrowed posteriorly, the border produced into two low lobes separated by a broad shallow emargination (in the unique type slide, the apex of the tergite is somewhat damaged and may be somewhat different from the figure and description). Basistyle, *b*, slender, the setæ sparse and relatively inconspicuous; apical lobe long and slender, with scattered black spicules; interbase a long narrow blade, gently sinuous, narrowed to the acute tip, the surface with abundant appressed setulæ. Dististyle, *d*, a narrow paddlelike blade. Phallosome, *p*, including short obtuse gonapophyses and a longer ædeagus, capitate at apex.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, October 10, 1954 (*Kintaro Baba*); Baba No. 294. Allotopotype, female.

The present fly is quite distinct from *Pedicia* (*Tricyphona*) *vetusta* (Alexander), which is the nearest relative, differing in the hypopygial characters, particularly the tergite, apical lobe of basistyle, interbase, and dististyle. The coloration of the female specimen herein assigned as being conspecific is sufficiently distinct to warrant the suspicion that it may be incorrectly placed with the holotype male.

2 (265). DICRANOTA (RHAPHIDOLABIS) PARACONSORS Alexander.

Dicranota (*Rhaphidolabis*) *paraconsors* ALEXANDER, Ann. Ent. Soc. America 48 (1955) 372.

The type was from Yatsugatake, Shinano, altitude 2,000 meters, August 10, 1949, collected by Syusiro Ito.

The venation is shown (Plate 1, fig. 1); male hypopygium (Plate 1, fig. 6).

HEXATOMINI

3 (266). PARADELPHOMYIA (OXYRHIZA) MACRACANTHA sp. nov.

Size small (wing, male, about 4.5 millimeters); general coloration of thorax testaceous yellow; legs pale brown, tibial spurs two, long and slender; wings weakly tinged with brown; macrotrichia of cells numerous; Sc_1 long, more than one-half Rs; petiole of cell M_1 long, nearly three times the cell; male hypopygium with the dististyles subterminal, apex of basistyle produced into a stout spine; outer dististyle unusually slender; spines of ventral fork unusually long and slender, approximately equal in length to the gonapophyses.

Male.—Length, about 3.5 millimeters; wing, 4.5; antenna, about 0.8.

Female.—Length, about 3.5 millimeters; wing, 4.

Rostrum brown; palpi dark brown. Antennæ dark brown or brownish black; flagellar segments oval, with long verticils, the outer segments still longer. Head brown.

Thorax obscure testaceous yellow, vaguely patterned with brown on the praescutum and dorsal pleurites. Halteres weakly infuscated. Legs with the coxæ and trochanters testaceous yellow; remainder of legs brownish yellow to pale brown; tibial spurs two, both unusually long and slender. Wings (Plate 1, fig. 4) weakly tinged with brown, the prearcular and costal fields a trifle more yellowed; stigma poorly indicated; veins light

brown, a little paler in the costal field. Macrotrichia well distributed in outer wing cells, from R_2 to Cu inclusive (position shown in figure by stippling). Venation: Sc_1 long, approximately one-half Rs; R_{2+3} and R_2 subequal; petiole of cell M_1 long, nearly three times the cell.

Abdomen, including hypopygium, brown. Male hypopygium (Plate 1, fig. 3) with the dististyles, *d*, subterminal, the apex of basistyle, b, produced into a stout and relatively short spine, provided with long setæ almost to the pointed tip; outer setæ of basistyle long and powerful. Outer dististyle, *d*, glabrous, unusually slender, the axial spine longest, the outer one very reduced. Spines of the ventral fork of the phallosome, *p*, unusually long and slender, widely separated at their bases, glabrous, approximately equal in length to either the gonapophysis or the ædeagus.

Habitat.—Japan (Honshu).

Holotype, male, Kami-Ishikawa, Echigo, June 27, 1954 (*Hiroshi Koike*); Baba No. 226. Allotype, female, Kurokawa, Echigo, July 18, 1954 (*Kintaro Baba*).

The present fly is quite distinct from the other regional small members of the genus in the tibial spurs, details of venation, and structure of the male hypopygium. The closest of such related forms is *Paradelphomyia* (*Oxyrhiza*) *nipponensis* (Alexander), which has the apical spine of the basistyle more elongate and the spines of the ventral fork shorter.

4 (267). TAIWANOMYIA BABAELLA sp. nov.

General coloration brownish black, the præscutum with three broad brown stripes; antennæ of male very elongate, about one-half longer than the wing; wings heavily patterned with brown, including paler brown washes over the base and disk; Rs about four times the basal section of vein R_5; cell M_1 lacking; cell 1st M_2 elongate about one-half longer than the distal section of vein M_{1+2}; m-cu beyond the fork of M.

Male.—Length, about 3.4 to 3.5 millimeters; wing, 4 to 4.2; antenna, about 6 to 6.2.

Rostrum and palpi black. Antennæ of male very elongate, about one-half longer than the wing; scape and pedicel small, black, flagellum pale brown; segments very long-cylindrical, with relatively inconspicuous erect setæ that are about one-fourth as long as the segment. Head brownish gray; anterior vertex about as wide as the diameter of the vertex.

Pronotal scutum brownish black, scutellum and pretergites whitened. Mesonotal præscutum chiefly covered by three broad brown stripes, the restricted interspaces darker brown; pseudosutural foveæ and tuberculate pits black; posterior sclerites of notum brown, the pleurotergite darker. Pleura dark brown, with a broad more blackened dorsal stripe. Halteres with stem light brown, yellow at base, knob brownish black. Legs with coxæ dark brown; trochanters testaceous yellow; femora obscure yellow with a virtually terminal darker ring, the extreme tip and narrow base of tibiæ whitened; tibiæ and tarsi yellowish brown, the outer tarsal segments a trifle darker; tibial spurs distinct. Wings (Plate 1, fig. 5) with the ground color of the costal fourth whitened, the center of the disk more clouded with darker; a heavy brown costal pattern, including major areas in cell C, origin of Rs, fork of Sc, confluent with a band along cord, tip of vein R_1 and over vein R_2; tips of remaining longitudinal veins darkened, largest on R_3 and on the anal veins, smallest near the wing tip, lacking on vein R_5 which is narrowly pale; the central clouded portion is especially evident in cells M and the Anals; veins brown, more yellowed in the costal interspaces. Venation; Sc relatively short, Sc_1 ending about opposite the fork of Rs, Sc_2 at its tip; Rs about one-fourth longer than R_{2+3+4} and nearly four times as long as the basal section of Rs; R_{2+3} and R_2 subequal, a little longer than the basal section of R_3; cell M_1 lacking; cell 1st M_2 elongate, about one-half longer than the distal section of vein M_{1+2}; m-cu about one-fourth to one-half its length beyond the fork of M; vein 2nd A curved strongly into the wing margin.

Abdomen, including hypopygium, brownish black.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, August 17, 1954 (*Kintaro Baba*); Baba No. 142. Paratopotypes, males, August 18, 1954; Kurokawa, July 14, 1955, August 23 to 26, 1955; Baba No. 383, Paratypes, 1 male, 1 female, Mount Donden, Sado Island, altitude 600 meters, June 19, 1955; Baba No. SA 37.

I take great pleasure in naming this very distinct fly for Dr. Kintaro Baba, who has made many outstanding discoveries in the crane-flies of Japan. The species is entirely distinct from *Taiwanomyia filicornis* (Alexander), the only other member of the genus at present known from Japan, in the conspicuously patterned wings. In the latter regard it is more like *T. fragili-*

cornis (Riedel), of Formosa, which is quite distinct in its venation.

During the past thirty years rather numerous species of this group have been discovered, showing a considerable range in venation and quite bridging the characters formerly used to separate the two supposed genera *Taiwanomyia* and *Troglophila*. It no longer seems advisable to attempt to maintain the two groups as distinct. The three generic names that have been proposed in this particular section are as follows:

Taiwanomyia ALEXANDER, Philip. Jour. Sci. 22 (1923) 476–477; type, *fragilicornis* (Riedel, 1916)—Formosa.

Troglophila BRUNETTI, as *Limnophila* (*Troglophila*) BRUNETTI, Rec. Indian Mus. 26 (1924) 99–100; type, *cavernicola* (Brunetti, 1924) - Assam.

Esakiomyia ALEXANDER, Ann. and Mag. Nat. Hist. (9) 15 (1925) 73–75; type *filicornis* ALEXANDER, 1925—Honshu.

Riedel's figure of the wing of *fragilicornis* [as *Taseocera fragilicornis*, Arch. für Naturgeschichte 82A 5 (1916) 112, fig. 2] is excellent but was published in a journal that is not generally available. Its venation is shown (Plate 1, fig. 8) for comparison with that of the present fly (Plate 1, fig. 5) and with *filicornis* (Plate 1, fig. 7).

5 (268). **TAIWANOMYIA FILICORNIS** (Alexander).

Esakiomyia filicornis ALEXANDER, Ann. and Mag. Nat. Hist. (9) 15 (1925) 74–75.

The type was from Mount Hakone, Sagami, altitude 2,300 feet, July 12, 1933, taken by Teiso Esaki.

Kurokawa, Echigo, altitude 300 meters, August 23, 1955 (*Kintaro Baba*); Baba No. 876.

The venation (Plate 1, fig. 7) is shown for purposes of comparison with that of *Taiwanomyia babaella* sp. nov. (Plate 1, fig. 5).

6 (269). **PSEUDOLIMNOPHILA TELEPHALLUS** sp. nov.

General coloration dark gray, præscutal stripes scarcely differentiated; knobs of halteres weakly infuscated; femora dark brown to brownish black, their bases yellow; wings weakly infuscated, stigma narrow, pale brown; cell M_1 present; abdomen, including hypopygium, black; male hypopygium with the outer dististyle long, slender, sinuous, narrowed to the acute tip, the outer and spinulose; ædeagus very long and conspicuous, jutting from the genital chamber as a vertical loop, the concave surface of the coil with hyaline membrane that bears

scattered microscopic spines.

Male.—Length, about 6.5 to 7.5 millimeters; wing, 7.5 to 9; antenna, about 1.8 to 2.0.

Female.—Length, about 7.5 millimeters; wing, about 8.

Rostrum brown; palpi black. Antennæ with scape and pedicel black, succeeding segments dark, in cases with the outer flagellar segments paler; basal flagellar segments cylindrical, the outer ones still longer with very long verticils. Head gray; anterior vertex moderately broad, about twice the diameter of the scape; a small median tubercle on anterior vertex.

Thoracic notum dark gray, præscutal stripes scarcely differentiated; pronotal scutellum restrictedly obscure yellow. Pleura dark gray. Halteres with stem yellow, knob weakly infuscated. Legs with the coxæ pale yellow, the fore pair slightly more darkened basally; trochanters yellow; femora with tips dark brown to brownish black, more extensively so on fore legs; tibiæ and tarsi brownish yellow, outer tarsal segments darker. Wings (Plate 1, fig. 9) with a weak brownish tinge, the prearcular and costal regions more yellowed; stigma narrow, pale brown; veins pale brown. Venation: Sc_1 ending shortly before level of fork of Rs, Sc_2 near its tip; R_{2+3+4} variable in length, commonly about twice the basal section of R_5; cell M_1 about one-third to one-half longer than its petiole; m-cu at near one-third its length beyond the fork of M.

Abdomen, including the hypopygium, brownish black, only the ædeagus obscure yellow. Male hypopygium (Plate 1, fig. 10) with the outer dististyle, *d*, long and slender, sinuous, gradually narrowed to the acute tip; surface of more than the outer third with microscopic spinules; inner style fleshy, nearly as long as the outer, cylindrical, narrowed outwardly, with abundant long setæ Phallosome, *p*, with the gonapophysis bispinous; ædeagus very long and conspicuous, arising from an enlarged basal portion, thence coiled vertically and projecting ventrad from the genital chamber, the concave surface of the narrowed part with hyaline membrane that is set with scattered microscopic spines.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, May 29, 1954 (*Kintaro Baba*); Baba No. 204. Paratopotypes, males, June 11, 1955; paratypes, 1 male, Tamagawa, Ugo, altitude 350 meters, June 18, 1951 (*Issiki-Ito*); males and females, Lake Tazawa, Ugo, altitude 260 meters, June 13, 1951 (*Issiki-Ito*).

Pseudolimnophila telephallus is quite distinct from other generally similar regional members of the genus, including *P. chikurina* Alexander and *P. inconcussa* (Alexander), in the very distinct male hypopygium. The other species have the ædeagus short and inconspicuous.

7 (270). LIMNOPHILA (ELÆOPHILA) KINTARO sp. nov.

Size relatively large (wing, 7 millimeters or more); general coloration of thorax dark brown, the præscutum and scutum more chestnut brown; halteres and legs yellow; wings brownish yellow, with a restricted brown pattern and with sparse macrotrichia in the outer cells; male hypopygium with the lobe of the outer dististyle very large, broad-based.

Male.—Length, about 5.5 to 6 millimeters; wing, 7 to 7.5; antenna, about 1.5 to 1.6.

Female.—Length, about 7.5 millimeters; wing, 7.5.

Rostrum and palpi black. Antennæ with scape dark brown, pedicel and proximal flagellar segments testaceous yellow, outer flagellar segments infuscated; basal flagellar segments short-oval, the outer ones longer, with a short erect pubescence and long verticils. Head dark brown.

Pronotum dark brown, scutellum more chestnut brown. Mesonotal præscutum and scutum chestnut brown, virtually unpatterned except for a capillary dark median vitta and lateral borders on the præscutum, pseudosutural foveæ large, black; posterior sclerites of notum and the pleura darker brown, the ventral part of the latter somewhat paler. Halteres yellow. Legs with coxæ infuscated, vaguely paler at tips; remainder of legs yellow, the outer tarsal segments a trifle darker. Wings (Plate 1, fig. 12) with the ground brownish yellow, the prearcular and costal fields somewhat clearer yellow; a restricted brown pattern, including the stigma, and spots and seams at h, near base of Sc, origin of Rs, fork of Sc, cord outer end of cell 1st M_2, fork of M_{1+2}, and spots at ends of certain of the longitudinal veins, largest on R_3 and R_4, much smaller on the medial, cubital and anal veins, virtually lacking on veins R_5, M_1 and M_2; veins brownish yellow, clearer yellow in the prearcular and costal regions, darker in the patterned portions. Sparse macrotrichia in outer ends of cells R_4 to M_1, inclusive, in cases more restricted, most persistent in cells R_4 and R_5 (their position indicated by stippling in figure). Venation: Sc_1 ending shortly before origin of Rs, the latter weakly an-

gulated at origin; cell M_1 subequal to or longer than its petiole; m-cu at or beyond midlength of cell 1st M_2; supernumerary crossvein in cell M nearly opposite origin of Rs.

Abdomen dark brown, hypopygium more brownish yellow. Male hypopygium (Plate 1, fig. 11) with the lobe of the outer dististyle, *d*, very large, its base extensive, apical hook of style small; surface and margins without microscopic spinulæ, as common in many species of the subgenus; inner style fleshy, narrowed outwardly, with numerous strong setæ. Phallosome, *p*, relatively small; ædeagus, *a*, short and slender.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, May 28, 1954 (*Kintaro Baba*); Baba No. 150. Allotopotype, female, May 29, 1954. Paratopotypes, males and females, May 28 to June 10, 1954.

This distinct fly is named in honor of Doctor Kintaro Baba. It differs from all other regional members of the subgenus in the macrotrichia of the outer cells of the wing and in the structure of the male hypopygium, particularly the outer dististyle. In its general appearance it is most like *Limnophila* (*Elæophila*) *persalsa* Alexander, *L.* (*E.*) *screnensis* Alexander, and *L.* (*E.*) *ussuriana iwatensis* Alexander, differing from all in the features above indicated. Species of the subgenus in the eastern Nearctic region likewise have macrotrichia in the outer cells of the wing and a supposed new subgeneric group, *Trichephelia* Alexander, was proposed for them, based primarily on this character. However, in the light of more recent discoveries in the Tipulidæ it scarcely seems advisable to try to maintain the name *Trichephelia*.

8. (271). NIPPOLIMNOPHILA PERPRODUCTA sp. nov.

General coloration dark brown, sparsely pruinose; antennæ of male longer than the body and almost equal to the wing; male hypopygium with the tergite produced into a slender median lobe; ædeagus relatively long and slender, sinuous.

Male.—Length, about 3.5 millimeters; wing, 4.5; antenna, about 4.

Rostrum dark brown; palpi brown, short, the terminal segment very small. Antennæ of male very long, exceeding the body, brown; flagellar segments very long-cylindrical, with dense erect setæ and pubescence; second flagellar segment at least ten times as long as thick; scape only about one-third as long as the first flagellar segment; apex of antenna broken

and the number of segments cannot be definitely stated. Head dark brown; anterior vertex broad, about four times the diameter of the scape.

Pronotum and mesonotum dark brown, sparsely pruinose, the posterior sclerites of the latter somewhat paler. Pleura dark brown, sparsely pruinose. Halteres elongate, pale yellow. Legs with the coxæ brown, trochanters more testaceous; remainder of legs obscure yellow, the tips of the femora and tibiæ, with the outer tarsal segments, slightly darker. Wings (Plate 2, fig. 13) whitish subhyaline, the costal border a trifle more yellowed; stigma very vaguely darker; veins pale brown. Macrotrichia of outer veins sparse and scattered. Anal angle of wing lacking. Venation: Sc_2 at extreme tip of Sc_1, opposite two-thirds the length of Rs; R_2 not apparent in the type; cell 1st M_2 large, subequal to vein M_{3+4}; cell 2nd A narrow.

Abdomen brown, including the hypopygium. Male hypopygium (Plate 2, fig. 14) with the tergite, *t*, produced into a slender median lobe that is a little stouter than in *omogiana*. Outer dististyle, *d*, with the apex a flattened dark-colored blade, the lower or inner face with microscopic appressed spinulæ; inner style shorter, narrowed beyond base, blackened, curved gently to the obtuse tip. Gonapophysis, *g*, appearing as a flattened blade that is extended into an apical spine, shorter than in *omogiana*. Ædeagus relatively long and slender, sinuous.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, May 2, 1954 (*Kintaro Baba*); Baba No. 219.

Of the three species of *Nippolimnophila* previously described, the present fly is closest to *N. omogiana* Alexander, of Shikoku, which is well distinguished by the much shorter antennæ and by slight details of structure of the male hypopygium.

ERIOPTERINI

9 (272). CLADURA (CLADURA) SUPERNUMERARIA sp. nov.

Allied to *machidella;* general coloration of thorax brownish yellow, præscutum and scutal lobes patterned with darker, scutellum and pleura yellow; antennal flagellum brownish black; femora yellow, the tips narrowly brownish black; wings very pale yellow, the costal border brighter, veins chiefly blackened, cord and Cu narrowly seamed with brown; supernumerary crossveins in cells R_3 and R_4; abdominal tergites

brown, subterminal segments still darker; male hypopygium with posterior border of tergite broadly emarginate, the lobes slender; dististyle broad, its apex short and obtuse, gonapophyses black, longer than the small slender ædeagus.

Male.—Length, about 6.5 to 7 millimeters; wing, 7 to 7.5.

Female.—Length, about 7.5 millimeters; wing, 9.

Rostrum and palpi dark brown. Antennæ brownish black, the scape paler. Head dark gray.

Pronotum obscure brownish yellow, darker laterally. Mesonotal præscutum brownish yellow, with three dark stripes, the broader central one opaque black, the lateral pair much paler to scarcely defined; scutum obscure yellow, the lobes with opaque blackened centers; scutellum light yellow; postnotum yellow, the central part of the mediotergite more infuscated. Pleura yellow, the anepisternum weakly infuscated. Halteres light yellow. Legs with the coxæ and trochanters yellow; femora yellow, the tips narrowly brownish black; tibiæ and basitarsi obscure yellow, the tips more narrowly darkened; remaining tarsal segments passing into black. Wings (Plate 2, fig. 17) very pale yellow, the prearcular and costal fields clear light yellow; a restricted dark pattern, chiefly involving the veins slightly more extensive over the cord, Cu and the supernumerary crossveins. Venation: Supernumerary crossveins in cells R_3 and R_4, in approximate alignment with R_2, which lies near the outer end of the yellow stigmal area, a little shorter than R_{1+2}; cell M_1 deep, its petiole subequal to or a trifle longer than m.

Abdominal tergites brown, the subterminal segments in male still darker brown to form a ring; hypopygium brown. Male hypopygium (Plate 2, fig. 18) with the tergite elongate, the posterior border broadly and shallowly emarginate, the lateral lobes very slender. Basistyle, *b*, elongate, the proximal half of mesal face more expanded, with pale membrane and abundant setæ. Dististyle, *d*, broad, the apex short and obtuse, with a concentration of short dark-colored setæ; dorsal margin of style elevated into a very low ridge or flange. Gonapophysis, *g*, black, conspicuous, each consisting of two larger outer blades, the inner one of which terminates in an acute point, its edge microscopically serrulate; outer blade with coarser denticles and a triangular toothed flange. Ædeagus shorter than the gonapophysis, its outer half very slender.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, November 7, 1954 (*Kin-*

taro Baba); Baba No. 327. Allotopotype, female, November 24, 1954. Paratopotypes, 2 males, November 7 to 24, 1954.

Other Japanese species of the genus having supernumerary crossveins in the wing cells include *Cladura* (*Cladura*) *fuscivena* Alexander, *C.* (*C.*) *machidella* Alexander, and *C.* (*C.*) *microphallus* Alexander. The present fly is closest to *microphallus* in the small ædeagus, differing evidently in all details of structure of the hypopygium, including the tergite, dististyle, and gonapophyses. *C.* (*C.*) *fuscivena* is known to me only in the female sex. It lacks the supernumerary crossvein in cell R_4 of the wings, as found in the other species, but this character may prove to be inconstant in a series of specimens.

10 (273). CLADURA (CLADURA) ITOI Alexander.

Cladura (*Cladura*) *itoi* ALEXANDER, Bull. Brooklyn Ent. Soc. 50 (1955) 19–30.

The type was from Sigakôgen, Shinano, altitude 1,600 meters, taken September 11, 1953, by Syusiro Ito.

Male hypopygium (Plate 2, fig. 19) of the *megacauda* type but even more accentuated, representing the extreme of ornamentation as far as known in the genus. Ninth segment large and complex, the tergite and sternite fused into a continuous ring; tergal region produced into two relatively slender dorsally directed lobules; cephalad of these with a group of long erect pale setæ; region of sternite with abundant long erect pale setæ. Basistyle, *b*, elongate, erect, its ventral margin rounded, with a brush of very long setæ; basal lobe of mesal face of style deeply bilobulate, the larger lobule foot-shaped, the appressed smaller one fingerlike, tipped with a few long setæ; apical lobe of style subequal to or a little longer than the style itself, very slender, terminating in three or four long setæ, with other scattered erect very long bristles down the outer margin. Dististyle, *d*, stouter than the apical lobe of basistyle, a little more than one-half as long, near its base with a slender erect rod that is fully one-fourth as long as the style; apex of style with a dense brush of black setæ, with fewer similar darkened setæ on the cephalic and mesal faces. Gonapophysis, *g*, about equal in length to the ædeagus, appearing as a flattened blade, the outer margin with microscopic denticles, the apical spine largest.

11 (274). CLADURA (CLADURA) SAWANOI sp. nov.

Allied to *megacauda;* general coloration yellow, the meso-

notal præscutum and scutum conspicuously patterned with polished black spots; tips of femora narrowly brownish black; wings subhyaline, unpatterned; male hypopygium very large; ninth tergite with the upper lobes slightly divergent, the inner apical angle produced mesad into a fingerlike lobe; cephalic lobe of basistyle relatively stout, with a row of strong setæ extending the entire length; gonaphophyses appearing lyriform, each a powerful sclerotized rod, the apex unequally bidentate; ædeagus small.

Male.—Length, about 7 millimeters; wing, 8.

Female.—Length, about 7 millimeters; wing, 8.

Rostrum and palpi yellow. Antennæ yellow, the flagellum a little darker in the female. Head yellow.

Prothorax light yellow. Mesonotum yellow, conspicuously patterned with black spots, there being a pair near anterior end of præscutum, narrowly separated at midlength, and a widely separated pair near posterior border of præscutum, representing the usual lateral stripes; further black areas on scutum, in the holotype male with two marks on each scutal lobe, the inner one of each lobe small, in the allotype female the inner pair of spots lacking; remainder of notum and the pleura yellow. Halteres yellow. Legs with the coxæ and trochanters yellow; femora and tibiæ yellow, the tips narrowly but distinctly brownish black; tarsi dark brown to brownish black, the proximal end of basitarsus paler. Wings subhyaline, the prearcular and costal regions pale yellow, including the veins, the remaining veins light brown. Venation: Vein R_2 very faint to scarcely evident, about one-fourth as long as R_{2+3}; cell M_1 deep, its petiole subequal to m; m-cu at or shortly beyond the fork of M.

Abdomen obscure yellow, in the male the posterior borders of the tergites vaguely darkened; hypopygium brownish yellow. Male hypopygium (Plate 2, fig. 20) very large, most nearly as in *megacauda*. Ninth tergite, *t*, about as shown, the upper lobes divergent, their inner apical angle produced mesad into a fingerlike lobe; ventral tergal lobes shorter, obtuse. Region of ninth sternite with abundant very long and conspicuous setæ. Apical lobe of basistyle, *b*, a little more than one-half as long as the body of style, flattened, slightly widened outwardly, with conspicuous setæ; at proximal end of basistyle on mesal face with two lobes, the outer bilobulate, the second lobe longer, with a row of relatively short setæ extending

the entire length. Dististyle, *d*, a trifle longer than the outer lobe of basistyle, gradually narrowed outwardly, the surface with long very pale setæ, apex obtuse, with short stiff setæ. Gonapophyses, *g*, lyriform, appearing as very stout arms that are united at the midline, the outer ends of the arms strongly carinate, the apex unequally bidentate, the outer tooth spinous, the inner or apical one more obtuse. Ædeagus small, shorter than the apophyses.

Habitat.—Japan (Honshu).

Holotype, male, Mount Daisen, Hoki, altitude 800 meters, November 8, 1954 (Zyuzô Sawano). Allotopotype, female, November 9, 1954.

This interesting crane-fly is dedicated to the collector, Dr. Zyuzô Sawano, friend and colleague of Dr. Kintaro Baba. The species is closest to *Cladura* (*Cladura*) *megacauda* in the armature of the basistyle of the male hypopygium, differing conspicuously in the other structures of the hypopygium and in the coloration of the thorax. The arrangement of markings on the mesonotum suggests the condition in *C.* (*C.*) *decemnotata* Alexander and some allied species which belong to a different group of the genus with the hypopygial structure quite distinct.

12 (275). CLADURA (CLADURA) RECURVALIS sp. nov.

Allied to *megacauda;* size medium (wing, 7 millimeters); general coloration of body and appendages light yellow; tips of femora and tibiæ narrowly darkened; male hypopygium with the tergite narrowed outwardly, terminating in two flattened glabrous blades that are slightly divergent; outer lobe of basistyle shorter than the dististyle; ædeagus very large, recurved, the outer two-thirds heavily sclerotized, the apex scooplike, with a single strong spinous subapical spine.

Male.—Length, about 6 millimeters; wing, 7.

Rostrum brown; palpi yellow. Antennæ yellow, the bases of the flagellar segments a trifle more darkened. Head uniformly yellow.

Thorax uniformly light yellow. Halteres relatively long, yellow, the tips of the femora and tibiæ very narrowly blackened, the former more extensively so; outer tarsal segments brownish black. Wings subhyaline, the prearcular and costal regions a trifle more yellowed; veins pale, especially in the brightened areas. Venation: R_{2+3+4} long, more than one-

third Rs; petiole of cell M_1 about one-half the cell.

Abdomen yellow, slightly patterned with pale brown, the eighth sternite conspicuously darker. Male hypopygium (Plate 2, fig. 21) with the tergite narrowed outwardly, divided into two flattened blades that diverge slightly, entirely glabrous, their tips obtuse. Basistyle, *b*, with the outer lobe elongate, with very long bristles on about the outer half of the inner face, not as concentrated as in some allied forms; mesal lobe unequally bifid, including a short truncated outer blade and a longer oval lobe that is densely setuliferous. Dististyle, *d*, about one-fourth longer than the outer lobe of the basistyle, gradually narrowed to the obtuse tip which bears only five or six long scattered setæ. Gonapophyses appearing as flattened blades, the tips obtuse. Ædeagus, *a*, distinctive, very large and conspicuous, decurved and thence directed cephalad to lie along the ventral floor of the genital chamber, the outer two-thirds heavily sclerotized; apex more dilated, terminating in a shallow scoop, before which is a single strong spine.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, November 1, 1954 (*Kintaro Baba*); Baba No. 324.

Cladura (*Cladura*) *recurvalis* is most like *C.* (*C.*) *telephallus* Alexander and *C.* (*C.*) *trifilosa* sp. nov., in the unusual development of the ædeagus, differing in all details of structure of the hypopygium, especially the tergite, lobes of the basistyle, dististyle, and particularly the ædeagus.

13 (276). **CLADURA (CLADURA) SHIRAHATAI** Alexander.

Cladura (*Cladura*) *shirahatai* ALEXANDER, Bull. Brooklyn Ent. Soc. 50 (1955) 21 22.

The type was from Sagata, Uzen, taken October 15, 1953, by Kotaro Shirahata, sent to me by Dr. Kintaro Baba.

Male hypopygium (Plate 2, fig. 22) with the tergite relatively large, its posterior border produced into two slender lobes that are separated by a U-shaped notch, with two further smaller and weaker lobules lying still more ventrad. Apical lobe of basistyle, *b*, a little more than one-half the length of the style itself, shorter than the dististyle, *d*, the latter clavate, broader at apex than at base, provided with sparse setæ; mesal lobe of basistyle stout, produced into a slender apical

lobule and a stouter more basal one. Phallosome, *p*, distinctive, the gonapophysis foot-shaped, its apex or sole microscopically corrugated; ædeagus slender, subequal in length to the apophysis.

14 (217). CLADURA (CLADURA) TRIFILOSA sp. nov.

Allied to *megacauda;* general coloration pale yellow; femora and tibiæ with tips narrowly darkened; abdomen brownish yellow, the posterior borders of the tergites slightly darker, the eighth sternite more heavily so; male hypopygium with the tergite terminating in two broad lobes that are separated by a circular notch; outer lobe of basistyle and the dististyle relatively short, subequal in size; gonapophysis oval, relatively narrow; ædeagus elongate, terminating in three conspicuous filiform rods.

Male.—Length, about 5.5 to 6.5 millimeters; wing, 6 to 7.

Female.—Length, about 5.5 to 6.5 millimeters; wing, 7 to 8.

Rostrum, palpi and antennæ pale yellow, the remainder of head a trifle darker.

Thorax uniformly pale yellow. Halteres yellow. Legs yellow the tips of the femora and tibiæ very narrowly blackened, the latter a little more narrowly so; tarsi passing into brownish black. Wings subhyaline or very pale yellow, veins pale brown, those in the prearcular and costal fields somewhat more yellowed. Venation: Both the petiole of cell M_1 and the position of m-cu very variable, in cases cell M_1 only a little longer than its petiole, in other specimens four or five times as long; m-cu ranging from just beyond fork of M to midlength of M_{3+4}.

Abdomen brownish yellow, the tergites vaguely patterned with pale brown on posterior borders; eighth sternite of male more conspicuously blackened to form a partial ring; hypopygium very large, pale brown. Ovipositor with cerci very long and slender. Male hypopygium (Plate 2, fig. 15) with the tergite produced into two broad lobes that are separated by a circular notch, the apices of the lobes extensively glabrous. Basistyle, *b*, with the apical lobe relatively short, partly constricted at base to simulate a dististyle; apex obtuse, with a concentration of long reddish bristles; mesal lobe small, more or less oval, with conspicuous setæ. Dististyle, *d*, of nearly the same size and shape as the outer lobe of the basistyle, its outer third narrowed, the setæ of the outer surface long and conspicuous, of the lower face

small and little evident. Phallosome with the blades of the gonapophyses oval, much narrower than in *telephallus*. Ædeagus extended, much as in *telephallus*, at the end of the dilated part constricted and produced into three elongate filiform rods, one a little shorter than the others, their tips pale and a little dilated; a single genital tube in the ædeagus despite the triple ending.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, November 1, 1954 (*Kintaro Baba*); Baba No. 324. Allotopotype, female. Paratopotypes, 3 males, 1 female.

The most similar species is *Cladura* (*Cladura*) *telephallus* Alexander, from the higher mountains of Honshu. The present fly is readily distinguished by the details of structure of the male hypopygium, including the tergite, dististyle, genapophysis and, especially, the ædeagus, as the three long-extended terminal filaments.

15 (278). TRENTEPOHLIA (MONGOMA) SUBPENNIPES sp. nov.

Allied to *pennipes;* general coloration of thorax and abdomen yellow; head light gray; legs pale brownish yellow, the tarsi and tips of tibiæ snowy-white; mid-tibiæ not dilated and without a fringe of elongate setæ.

Male.—Length, about 7 to 7.5 millimeters; wing, 7 to 7.5.

Rostrum and palpi testaceous yellow. Antennæ with the scape and pedicel yellow, flagellum brown; flagellar segments subcylindrical, verticils short. Head light gray; anterior vertex reduced to a narrow carinate strip.

Entire thorax, including pronotum and cervical region, pale yellow, the dorsum slightly more reddened than the pleura. Halteres yellow. Legs with the coxæ and trochanters yellow; femora pale yellow throughout; tibiæ similar, the tips whitened, somewhat more extensively so on the mid-tibiæ where about the outer fifth or sixth is included, the vestiture white but not long and outspreading as in *pennipes;* in the latter, the setæ on the slightly expanded tips of the mid-tibia exceed the diameter of the tibia at the point of insertion; in the present fly not or scarcely one-half the diameter; tarsi snowy-white throughout. Wings (Plate 2, fig. 16) subhyline; veins pale yellow, inconspicuous. Costal fringe short. Venation: R_{3+4} about one-half vein R_2 or less; apical fusion of Cu_1 and 1st A short.

Abdomen brownish yellow to obscure yellow, including the

hypopygium.

Habitat.—Japan (Honshu).

Holotype, male, Yoshigahira, Mount Sumon, Echigo, June 25, 1954 (*Kintaro Baba*); Baba No. 87. Paratypes, male, Kurokawa, Echigo, July 13, 1954 (*Kintaro Baba*); 1 female, Mount Donden, Sado Island, Sado, (*Kintaro Baba*); Baba No. SA 67. Aridagun, Kii, August, 1928 (*M. Horie*).

The defective specimen from Kii had been in my collection for several years and had been considered as being *Trentepohlia* (*Mongoma*) *pennipes* (Osten Sacken). The two flies are best distinguished by the structure and ornamentation of the legs, as described above. The present fly is the the most northerly representative of the subgenus *Mongoma* Westwood so far made known.

16 (270). GONOMYIA (IDIOCERA) NIGRILOBATA sp. nov.

General coloration of mesonotum pale brown, darker behind, the ventral pleurites yellow; legs obscure yellow; wings pale yellowish gray, restrictedly patterned with darker; cell R_3 large Sc_1 very long; male hypopygium with the apical lobe of basistyle terminating in an acute blackened spine, with abundant spinules back from the tip; three dististyles, the intermediate one forked, arising from a stout base; ædeagus slender, not blackened at apex, terminating in a short recurved hook.

Male.—Length, about 4.6 to 4.8 millimeters; wing, 5.2 to 5.5.

Rostrum brownish black; palpi black. Antennæ relatively long; scape, pedicel and first flagellar segment yellow, the scape more or less darkened at base; outer flagellar segments long-suboval, with very long verticils and a dense pale pubescence. Head obscure yellow, more infuscated behind.

Pronotum obscure yellow, narrowly darker medially, the pretergites clearer yellow; sides of pronotum dark brown. Anterior end of mesonotal præscutum pale brown, sparsely pruinose, the humeral and lateral regions yellow; posterior sclerites of notum, including the posterior end of the præscutum, darker, this represented by the ends of the intermediate stripes. Pleura yellow ventrally, a little darker on dorsal part. Halteres with stem pale, knob weakly infuscated. Legs with coxæ and trochanters yellow, the fore coxæ a little darker; remainder of legs obscure yellow, the tips of the femora and tibiæ narrowly darker; outer tarsal segments passing into brownish black. Wings (Plate 3, fig. 23) pale yellowish gray, the prearcular and costal regions clearer yellow; stigma small, pale brown, short-

oval; a vague darkening at origin of Rs, cord and m-cu, best-indicated by a deepening in color of the included veins which otherwise are brownish yellow, clear yellow in the brightened parts. Venation: Sc_1 ending about opposite one-third to one-fourth the strongly arcuated Rs, Sc_2 far retracted, Sc_1 alone subequal to Rs; distance on costa between tips of veins R_{1+2} and R_3 about one-half the latter; m-cu nearly twice its length before fork of M.

Abdominal tergites dark brown, the posterior borders of the segments yellow, more extensive on the outer segments; sternites and hypopygium obscure yellow or brownish yellow. Male hypopygium (Plate 3, fig. 24) with the lobe of the basistyle, *b*, very long, at apex narrowed into a black spine, the inner face back from the tip blackened and provided with abundant peglike spinules. There dististyles, *d*, the outer a simple curved sickle that narrows to a long acute spine; intermediate style conspicuously forked, the stem unusually short, outer arm longest, appearing as a parallel-sided rod, its tip obtuse, inner arm about two-thirds as long, broader, the tip acute; inner style a slender nearly straight rod, the tip acute, darkened, the lower margin with four or five erect setæ. Ædeagus unblackened, long, straight and unusually slender, the tip a short curved hook.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, July 8, 1954 (*Kintaro Baba*); Baba No. 216. Paratopotypes, 2 males.

Gonomyia (*Idiocera*) *nigrilobata* is quite distinct from other similar regional species, including *G.* (*I.*) *serrulifera* sp. nov., and *G.* (*I.*) *teranishii* Alexander, in the structure of the male hypopygium, especially the basistyle and ædeagus.

17 (280). GONOMYIA (IDIOCERA) SERRULIFERA sp. nov.

Size medium (wing slightly more than 5 millimeters); mesonotum chiefly dark brown, pleura and prothorax yellowed; femora obscure yellow; wings grayish yellow, unpatterned; Sc_1 ending before midlength of Rs, veins R_{1+2} and R_3 very narrowly separated at margin; male hypopygium with an unusual array of lobes and styles, including two apical lobes of the basistyle and four dististyles or branches thereof; ædeagus at apex forking into two blackened points, their surface scabrous.

Male.—Length, about 4.5 millimeters; wing, 5.3.

Rostrum brown; palpi dark brown. Antennæ with the scape and pedicel yellow, flagellum dark brown; flagellar segments elongate-suboval, a trifle shorter than the verticils. Head whitish gray, the center of the posterior vertex more darkened.

Prothorax and pretergites light yellow. Mesonotum dark brown, the sides of the præscutum broadly light brown, the humeral region restrictedly more yellowed; scutellum broadly yellowed posteriorly; postnotum dark brown, the pleurotergite and sides of the mediotergite yellow. Pleura yellow, with a broad paler stripe across the ventral pleurites, extending from the fore coxæ to the base of the abdomen. Halteres pale, knob weakly darkened. Legs with the coxæ and trochanters yellow, fore coxæ a very little darker; femora obscure yellow, tibiæ and tarsi a trifle darker, outer tarsal segments darker. Wings (Plate 3, fig. 25) grayish yellow, the prearcular and costal regions clearer yellow; stigma not indicated; veins brownish yellow, clearer yellow in the brightened fields. Venation: Sc moderately long, Sc_1 ending about opposite two-fifths the length of Rs, Sc_2 far from its tip; R_{1+2} and R_3 very narrowly separated from one another at the margin; cell 2nd M_2 about one-half longer than its petiole; m-cu about its own length before fork of M.

Abdominal tergites brown, sternites and hypopygium paler. Male hypopygium (Plate 3, fig. 29) with both the basistyle and dististyles with an unusual number of branches. Basistyle, *b*, terminating in a long stout fleshy lobe, and a shorter and more slender one, both pale, with abundant setæ. Four dististyles, *d*, or profound branches, including a long slender pale blade that narrows to an acute point; intermediate style subequal in length, prolonged into a long point, with a shorter lobe or branch at beyond two-thirds the length; a very small slender spine tipped with black; innermost style pale, narrowed and blackened at tip, with a few serrulations near apex and about six long erect setæ. Ædeagus distinctive, pale, forking into two blackened points, these scabrous, with several appressed spines, the apical one longest.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, July 18, 1954 (*Kintaro Baba*); Baba No. 222.

Among the described regional species, this fly is most like *Gonomyia* (*Idiocera*) *kuwayamai* Alexander, differing in the coloration and details of venation. The structure of the male hypopygium in *kuwayami* is not known to me. In the present species this is unusually complicated, as described.

18 (231). GONOMYIA (GONOMYIA) GRACILISTYLUS Alexander.

Gonomyia (*Gonomyia*) *gracilistylus* ALEXANDER, Ann. and Mag. Nat. Hist. (9) 15 (1925) 70–71.

The type was from Mount Hakone, Sagami, altitude 2,300 feet, taken July 13, 1923, by Teiso Esaki. There are further records from various stations in Kyushu.

Kurokawa, Echigo, June 9, 1954 (*Kintaro Baba*); Baba No. 222.

The venation (Plate 3, fig. 26) and the male hypopygium (Plate 3, fig. 30) are shown. The species is most likely allied to *Gonomyia* (*Gonomyia*) *abbrevata* Loew, of the western Palæarctic region, differing conspicuously in the structure of the male hypopygium. Whether the species should more properly be placed in the subgenus *Lipophleps* Bergroth remains in question.

1♂ (282). GONOMYIA (GONOMYIA) KUROKAWÆ sp. nov.

Size small (wing of male 4.5 millimeters); mesonotum medium brown, pleura yellow; legs obscure yellow; wings with a faint brownish tinge, stigma scarcely darker; Sc_1 ending shortly beyond origin of Rs; cell M_2 open by atrophy of basal section of M_3, cell 2nd M_2 about twice its petiole; abdominal tergites bicolored, brown, bordered with yellow; male hypopygium with the outer lobe of the inner dististyle blackened, its truncated apex serrulate; ædeagus long, obtuse at tip, subtended by two strong blackened gonapophyses that are slightly unequal in shape.

Male. Length, about 3.7 millimeters; wing, 4.5.

Rostrum and palpi brownish black. Antennæ dark brown throughout; flagellar segments elongate, with very long verticils. Head bright yellow.

Pronotum and pretergites bright yellow. Mesonotum light to medium brown, the præscutum with a narrow darker line on anterior part; mid-region of scutum yellow; scutellum obscure yellow, restrictedly darkened medially at base; mediotergite yellow anteriorly, more infuscated behind. Pleura and pleurotergite yellow. Halteres with stem pale, knob weakly infuscated. Legs with the coxæ and trochanters light yellow; remainder of legs obscure yellow, the outer tarsal segments weakly infuscated. Wings (Plate 3, fig. 27) with a faint brownish tinge, the costal border a trifle more yellowed; stigma scarcely darker; veins very pale brown. Venation: Sc_1 ending shortly beyond origin of Rs, Sc_2 very faintly indicated; cell R_3 large, vein R_4 fully as long as R_{2+3+4}; cell M_2 open by atrophy of basal section of M_3; cell 2nd M_2 approximately twice its petiole; m-cu close to fork of M.

Abdominal tergites brown, the posterior and lateral borders yellow; sternites yellow; hypopygium brownish yellow. Male hypopygium (Plate 3, fig. 31) with the basistyle, *b*, stout, the outer apical lobe small, much shorter than either dististyle. Outer dististyle, *d*, a simple straight rod, the tip obtuse, outer half with very long setæ; inner style broader, at apex produced into a lobe that bears the two usual fasciculate or modified setæ; on outer margin beyond midlength with a blackened blade, its truncated apex serrulate. Two very strong gonapophyses, *p*, that are heavily blackened, acutely pointed at tips, differing slightly from one another in conformation. Ædeagus a long yellow rod, the blunt tip recurved.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, June 9, 1954 (*Kintaro Baba*); Baba No. 220.

Gonomyia (*Gonomyia*) *kurokawæ* differs from all other regional species by having cell M_2 of the wings open by the atrophy of the basal deflection of M_3. In *G.* (*G.*) *luteipleura* Alexander, the cell is open by the atrophy of *m*. Other somewhat similar species having cell 1st M_2 closed include *G.* (*G.*) *gilvipennis* Alexander and *G.* (*G.*) *omogœnsis* Alexander, which have the male hypopygium quite distinct.

29 (283). GONOMYIA (GONOMYIA) NECOPINA sp. nov.

Size small (wing of male less than 4.5 millimeters); mesonotum brownish gray, the scutellum, sides of mediotergite, pleurotergite and pleura yellow; wings with Rs and R_{2+3+1} subequal in length, cell R_3 relatively small; male hypopygium with the outer margin of the inner dististyle bearing a flattened blade and an outer spine; gonapophyses two, subequal in length but one more slender; ædeagus without an apical spine.

Male.—Length, about 3 to 3.5 millimeters; wing, 3.5 to 4.3.

Female.—Length, about 5 millimeters; wing, 5.

Rostrum yellow; palpi black. Antennæ black, scape paler at base; flagellar segments elongate-suboval, with moderately long verticils and a dense erect pale pubescence. Front yellow, vertex darkened.

Pronotum and pretergites light yellow. Mesonotal præscutum and scutum dark brownish gray, the lateral præscutal borders and interspaces, with the central region of scutum, paler; scutellum yellow; mediotergite brownish gray, the lateral borders, with the pleurotergite, reddish yellow. Pleura reddish yellow, with a longitudinal ventral clearer yellow stripe, more diffuse

behind; in cases the entire pleura more uniformly pale yellow. Halteres with stem pale yellow, knob infuscated. Legs with the coxæ and trochanters yellow, the fore coxæ a trifle darker; remainder of legs pale brown, the femoral bases a little paler, the outer tarsal segments slightly darker. Wings (Plate 3, fig. 28) with a weak brownish tinge, the prearcular and costal fields a little more yellowed; veins pale brown, yellowed in the brightened fields. Costal fringe of male relatively long and conspicuous. Venation: Sc_1 ending opposite or just beyond origin of Rs, Sc_2 near its tip; Rs and R_{2+3+4} subequal in length, cell R_3 relatively small; m-cu at or close to fork of M.

Abdominal tergites brown, the incisures and lateral borders a trifle paler; sternites and hypopygium more yellowed. Male hypopygium (Plate 3, fig. 32) with the apical lobe of the basistyle, *b*, short and stout. Both dististyles, *d*, pale and only feebly sclerotized; outer style a long narrow blade that is extended into an acute hyaline point, setæ relatively few and restricted to the outer margin; inner style diagnostic, its body with a narrow spine lying above the apex, with a second much larger black blade that exceeds the main style in length, bearing a single strong setæ near base; apex of style terminating in the usual two modified setæ. Phallosome, *p*, with the ædeagus pale, its apex flaring or dilated; two blackened gonapophyses, subequal in length, one more slender.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, June 10, 1954 (*Kintaro Baba*); Baba No. 218. Allotopotype, female, June 9, 1954. Paratopotypes, a few males, July 9 to 13, 1954 (*Kintaro Baba*).

Gonomyia (*Gonomyia*) *necopina* is most readily told from its nearest relatives, *G.* (*G.*) *gilvipennis* Alexander and *G.* (*G.*) *omogoensis* Alexander, by the structure of the male hypopygium, especially the dististyles and phallosome.

21 (284). LIPSOTHRIX APICIFUSCA sp. nov.

General coloration of body pale yellow; legs yellow, the tips of the femora and tibiæ narrowly infuscated; wings with Rs long, approximately four times R_{2+3+4} basal section of R_5 short, only a little longer than r-m; male hypopygium with the outer dististyle narrowly obtuse at tip, the spine placed at near midlength; interbase moderately long, gently curved to the acutely pointed tip.

Male.—Length, about 7.5 millimeters; wing, 8; antenna, about 1.3.

Rostrum and palpi yellow. Antennæ short; scape and pedicel yellow, flagellum somewhat more obscure yellow; flagellar segments oval, shorter than the conspicuous verticils. Head yellow.

Thorax entirely pale yellow; præscutal interspaces with relatively sparse elongate setæ. Halteres with stem pale yellow, knob weakly infuscated. Legs with the coxæ and trochanters pale yellow; femora yellow, the tips narrowly but conspicuously brown; remainder of legs very pale yellowish white, the tips of the tibiæ more narrowly darkened; claws with a very long basal spine and apparently with very microscopic crowded spinules nearer base. Wings (Plate 4, fig. 33) pale yellow; veins darker yellow, their position clearly indicated, in part, by the abundant trichia. Venation: Rs long, approximately four times R_{2+3+4} basal section of R_5 short, subequal to or only a little longer than r-m, almost transverse in position; m-cu at or close to fork of M.

Abdomen clear yellow, the hypopygium even more brightened. Male hypopygium (Plate 4, fig. 39) with the outer dististyle, *d*, relatively short and stout, heavily blackened, the tip narrowly obtuse; spine of lower margin at near midlength. What have been interpreted as being interbases appear as moderately long gently curved rods, narrowed to the acutely pointed tips, the base dilated. In *tokunagai*, these structures are unusually long and slender, strongly sinuous, the long tips acute.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, September 10, 1954 (*Kintaro Baba*); Baba No. 270. Paratopotype, male.

The most similar regional species is *Lipsothrix tokunagai* Alexander, described from Mount Daisen, Hoki, where it was taken on July 2, 1931, by Tokunaga. This has the wings even clearer yellow, with the veins very pale and difficult to see against the ground; Rs shorter, less than three times R_{2+3+4} and the basal section of R_5 longer and more arcuated.

The homologies of the hypopygial structures here discussed as presumably representing interbases remain in question. Edwards had considered them to be gonapophyses (parameres) and they may well represent such structures despite their location.

22 (285). RHABDOMASTIX (SACANDAGA) ANGUSTICELLULA sp. nov.

Size medium (wing of male, 5 millimeters); mesonotal præscutum light brown, with three darker brown stripes, the median one not reaching the suture, each scutal lobe with a dark spot; legs black, the femoral bases yellowed; wings with a strong

blackish tinge; macrotrichia on outer veins; cell 2nd A very narrow, especially on outer end; made hypopygium with the gonapophysis terminating in a well-developed spatula; ædeagus bilobed at apex.

Male.—Length, about 4.5 millimeters; wing, 5; antenna, about 1.1.

Rostrum obscure yellow; palpi black. Antennæ with the scape testaceous, pedicel and flagellum black; basal flagellar segments short-oval, the outer ones more elongate, with long verticils. Head grayish brown above, obscure yellow beneath.

Pronotal scutum dark brown, scutellum and pretergites yellow. Mesonotal præscutum light brown with three dark brown stripes, the median one becoming obsolete far before the suture, the anterior ends of the lateral strips darker; scutal lobes with a darkened lateral spot; scutellum light brown; postnotum obscure yellow. Pleura chiefly yellow, clearest behind, vaguely patterned with brown on the propleura, anepisternum, ventral sternopleurite and meron. Halteres weakly infuscated, especially the knob, the base of stem pale. Legs with the coxæ and trochanters yellow; remainder of legs black, the femoral bases yellowed, narrowly so on the fore and middle legs, somewhat more extensively on the posterior pair, where about the proximal third or fourth is included. Wings (Plate 4, fig. 34) with a strong blackish tinge, unpatterned; veins darker. Macrotrichia on outer veins, lacking on Rs, R_{2+3+4} and R_3. Venation: Sc of moderate length, Sc_1 ending about opposite two-thirds Rs, the latter long; vein R_3 nearly erect, separated on margin from R_{1+2} by a distance nearly equal to its own length; basal sections of M_{1+2} and M_3 reduced; cell 2nd A very narrow, especially on its outer end.

Abdomen dark brown, the hypopygium scarcely brightened. Male hypopygium (Plate 4, fig. 37) with the basistyle, *b*, elongate, much longer than the dististyles. Outer dististyle, *d*, slightly clavate, with abundant appressed spinules on outer face and apex, the terminal decurved spine larger; inner style stout. Gonapophysis with the apical spatula well-developed. Ædeagus bilobed at tip.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, June 18, 1954 (*Kintaro Baba*); Baba No. 225.

The most similar regional species is *Rhabdomastix* (*Sacandaga*) *atrata* Alexander, which differs in the coloration and

venation. The present fly is especially well-distinguished by the very narrow cell 2nd A.

22 (286). RHABDOMASTIX (SACANDAGA) NEBULIFERA sp. nov.

Size relatively large (wing of male 6.5 millimeters); general coloration dark brownish gray; antennæ black throughout; fore legs chiefly infuscated, femora paler basally; wings with a brownish tinge, weakly patterned with darker clouds, the most evident at the cord, prearcular and costal fields more yellowed; abundant macrotrichia on veins beyond cord; Sc relatively long, Sc_1 ending nearly opposite three-fourths the length of Rs; cell 2nd A broad; male hypopygium with the outer blade of the gonapophysis narrow.

Male.—Length, about 5.5 millimeters; wing, 6.5; antenna about 1.4.

Rostrum and palpi black. Antennæ relatively short, black throughout; pedicel enlarged, flagellar segments oval, the outer ones more elongate; longest verticils unilaterally distributed; lower face of segments with conspicuous white pubescence. Head dark gray; anterior vertex broad.

Thorax dark brownish gray, the præscutum with a still darker central stripe that ends far before the suture; pseudosutural foveæ large, black. Pleura and pleurotergite dark brownish gray; dorsopleural membrane darkened. Halteres yellow. Legs with the fore coxæ darkened, remaining coxæ obscure yellow; trochanters yellow; fore femora chiefly infuscated, paler basally; remaining femora obscure yellow, the tips narrowly darkened; fore tibiæ and tarsi blackened, on the other legs paler; tarsi passing into black. Wings (Plate 4, fig. 35) with a brownish tinge, weakly patterned with darker clouds, especially over the cord and less evidently in cells R and M; stigma oval, medium brown; prearcular and costal fields light yellow; veins brown, more yellowed in the brightened fields. Macrotrichia on outer veins, including R_{2+3+4} and base of R_3. Venation: Sc relatively long, Sc_1 ending nearly opposite three-fourths Rs, Sc_2 apparently atrophied; vein R_3 oblique, the distance on costa between R_{1+2} and R_3 exceeding the length of the latter; Rs about one-third longer than R_{2+3+4}; veins issuing from cell 1st M_2 only moderately arched; m-cu beyond midlength of M_{3+4}; anal angle prominent, vein 2nd A sinuous, the cell broad.

Abdomen, including hypopygium, bronwish black. Male hypopygium (Plate 4, fig. 38) with the basistyle, *b*, very long, approximately three times the outer dististyle. Dististyles, *d*,

terminal; outer style narrow, the outer surface scabrous, with numerous appressed spinules, the terminal spine larger, decurved; inner style broad-based, narrowed to the slender tip, the surface with many setæ. Gonapophysis unusually long and slender, the blade very feebly dilated, acute at the tip. Ædeagus blackened, the tip obtuse, possibly broken in the unique type.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, July 17, 1954 (*Kintaro Baba*); Baba No. 229.

The present fly is very different from the most similar regional species, *Rhabdomastix* (*Sacandaga*) *japonica* Alexander, in the coloration of the body, legs and wings.

24 (287). ORMOSIA (ORMOSIA) ECHIGOENSIS sp. nov.

Belongs to the *similis* group; general coloration of the mesonotum yellowish brown, the præscutum with three very slightly darker brown stripes, pleura darker brown; antennæ testaceous yellow; legs golden yellow, the outer tarsal segments darkened; wings yellowish brown, stigma darker brown, the veins less evidently seamed with brown; abdomen dark brown, hypopygium abruptly brownish yellow; male hypopygium with the inner dististyle triangularly dilated on outer half; gonapophysis deeply bifid, the outer arm a powerful scabrous rod, the longer inner arm narrowed into a slender black spine.

Male.—Length, about 4.8 millimeters; wing, 5.7.

Rostrum brown; palpi black. Antennæ testaceous yellow, the outer segments darker; flagellar segments elongate-oval to subcylindrical, with long verticils. Head brown.

Pronotum brown, vaguely patterned with paler; pretergites light yellow. Mesonotum yellowish brown, the præscutum with three very slightly darker brown stripes; pseudosutural foveæ dark brown. Pleura and pleurotergite darker brown. Halteres light yellow. Legs with the coxæ and trochanters yellow; remainder of legs golden yellow, only the outer tarsal segments darkened, terminal segment black. Wings (Plate 4, fig. 36) yellowish brown, brighter yellow on the basal and costal portions; stigma darker brown; vague more darkened seams on most longitudinal veins; veins and macrotrichia darker brown. Trichia of cells very abundant, in all the cells (the position shown in figure by stippling). Venation: R_2 shortly beyond fork of R_{2+3+4}, leaving a short element R_{2+3}; cell M_2 open by atrophy of basal section of M_3; vein 2nd A gently sinuous on outer third.

Abdomen dark brown or brownish black, the hypopygium abruptly brownish yellow. Male hypopygium (Plate 4, fig. 40) with the posterior border of the ninth tergite produced caudad into a depressed central plate, indistinctly divided medially, the margin darkened but ill-delimited. Outer dististyle, *d*, with parallel rows of microscopic scales, as in the group; inner style dilated at base, thence constricted and finally triangularly expanded at near midlength. Gonapophysis, *g*, distinctive, deeply bifid, the outer arm a powerful rod, its surface roughened by microscopic scales, the longer inner arm expanded on more than the basal half, thence abruptly narrowed into a slender black spine. Ædeagus long and slender.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, October 16, 1954 (*Kintaro Baba*); Baba No. 305.

There are various other somewhat similar species of the *similis* group in Japan, all being most evidently separated from one another by the structure of the male hypopygium. Such species include *Ormosia* (*Ormosia*) *dicax* Alexander, *O.* (*O.*) *kamikochiæ* Alexander, *O.* (*O.*) *machidana* Alexander, *O.* (*O.*) *remissa* Alexander, *O.* (*O.*) *seclusa* Alexander, *O.* (*O.*) *takahashii* Alexander, *O.* (*O.*) *takeuchii* Alexander, and *O.* (*O.*) *tokunagai* Alexander. In the present fly, the chief distinguishing characters are found in the tergite, inner dististyle, and especially in the gonapophyses.

25 (235). MOLOPHILUS (MOLOPHILUS) BABANUS sp. nov.

Belongs to the *gracilis* group and subgroup; allied to *procericornis;* general coloration brownish black, sparsely pruinose; antennæ of male long and beadlike, approximately three-fourths as long as the wing, the flagellar segments with long erect verticils at near midlength; halteres infuscated; wings weakly infuscated, vein 2nd A unusually short, ending some distance before m-cu; male hypopygium with the dorsal lobe of the basistyle and both dististyles very long and slender, a smaller third dististyle bears about six setæ at apex; ædeagus with a conspicuous flange on basal three-fourths.

Male.—Length, about 4 to 4.2 millimeters; wing, 4.4 to 4.5; antenna, about 3.2 to 3.3.

Female.—Length, about 4.5 millimeters; wing, 5.

Rostrum and palpi black. Antennæ of male elongate, black throughout; flagellar segments elongate-fusiform, with abundant long outspreading verticils at near midlength of each segment.

Head black, sparsely pruinose.

Thorax brownish black, sparsely pruinose. Halteres infuscated, base of stem yellow. Legs with coxæ dark brown; trochanters brownish yellow; fore femora blackened, the bases obscure yellow, remaining femora pale, obscure yellow, with narrowly darkened tips; tibiæ and tarsi light brown. Wings weakly infuscated, the prearcular and costal fields slightly more yellowed; veins and macrotrichia darker brown. Venation: R_2 just beyond level of r-m; petiole of cell M_3 long, approximately three times m-cu; vein 2nd A unusually short, ending some distance before the level of m-cu.

Abdomen, including hypopygium, brownish black. Male hypopygium (Plate 4, fig. 42) with the dorsal lobe of the basistyle, *b*, long and slender, nearly as long as the inner dististyle, its apex glabrous, ventral lobe shorter and stouter. Three dististyles, *d*, the two longer ones entirely glabrous and unarmed, outer style black, strongly curved into a long slender spine, inner style nearly as long, with more than the basal half widened, the outer part more slender, the tip acute; third style very small but slender, with about six long setæ at outer end. Phallosome narrow, more or less oval, the apex narrowly obtuse. Ædeagus, *a*, with a broad basal flange that narrows outwardly, becoming obsolete at near three-fourths the length, the apical end sinuous, very slender and acute.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, June 1, 1954 (*Kintaro Baba*); Baba No. 194. Allotopotype, female, pinned with type. Paratopotypes, males.

This unusually interesting fly is named for the collector, Dr. Kintaro Baba, to whom we owe most of our present knowledge of the Tipulid fauna of Echigo. It constitutes the first record in Japan for any species of an extensive group of Oriental members of the genus, well represented in the Philippines and southward, of which *Molophilus* (*Molophilus*) *procericornis* Alexander, of the Philippines, may be considered as being typical. All of these species have elongate beadlike antennæ in the male sex and all are distinguished among themselves chiefly by the structure of the male hypopygium. The most northerly previously described member of the group is *M.* (*M.*) *hoplostylus* Alexander, of Formosa.

26 (289). MOLOPHILUS (MOLOPHILUS) PERFEROX sp. nov.

Belongs to the *gracilis* group and subgroup; allied to *ferox*; general coloration black; antennæ short; wings strongly in-

fuscated, veins and macrotrichia darker; vein 2nd A long; male hypopygium with the outer armature of the basistyle very large and complex, of two distinct parts; ventral lobe of style reduced, with about seven setæ; two dististyles, the outer one longer.

Male.—Length, about 4 millimeters; wing, 4.6; antenna, about 1.

Rostrum and palpi black. Antennæ short, brown; flagellar segments oval, passing into long-oval, with conspicuous verticils. Head brownish black.

Thorax black, the posterior border of the pronotal scutellum yellow. Halteres obscure yellow. Legs with the coxæ obscure yellow; trochanters clearer yellow; legs brownish yellow, the color appearing much darker because of the black vestiture; outer segments slightly darker. Wings strongly infuscated, the prearcular and costal regions slightly more yellowed; veins light brown, macrotrichia darker brown. Venation: R_2 lying shortly beyond level of r-m; petiole of cell M_2 nearly twice m-cu; vein 2nd A long and gently sinuous, terminating nearly opposite the base of cell M_2.

Abdomen, including hypopygium, black. Male hypopygium (Plate 4, fig. 43) very complex in structure; basistyle, *b*, with a large and complex apical armature on outer margin, including two distinct structures, one a flattened blade that is directed mesad into a long needlelike point, the other a comparably large flattened blade that divides into two points, the outer a more slender spine (in the figure these are shown separately from the two dististyles and as individual outlines at lower right); ventral lobe of basistyle very reduced, with only about seven setæ. Outer dististyle, *d*, longer, broad on more than the basal half, thence narrowed and bent into a slender blackened spine; inner style a gently curved sickle, narrowed to an acute spine, with a few scattered spinules on the lower or concave margin. Phallosome obtuse at apex; surface with microscopic setulæ. Ædeagus very long and slender.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, July 17, 1954 (*Kintaro Baba*); Baba No. 194.

Molophilus (*Molophilus*) *perferox* is most nearly related to *M.* (*M.*) *ferox* Alexander and *M.* (*M.*) *efferox* Alexander, from which it differs especially by the structure of the male hypopygium, particularly in the details of armature of the basistyle and in the dististyles.

27 (263 A). MOLOPHILUS (MOLOPHILUS) TRIACANTHUS DEBILISPINUS subsp. nov.

Very similar to typical *triacanthus*, differing in the details of structure of the male hypopygium.

Inner dististyle only slightly expanded on basal half, the stem being approximately twice the diameter of the outer spine. Phallosome narrow, the three spines relatively small and weak.

Habitat.—Japan (Honshu).

Holotype, male, Yoshikiya, Shinano, altitude 1,500 meters, July 28, 1951 (*Hiroshi Inoue*). Allotopotype, female, pinned with type.

28 (290). MOLOPHILUS (MOLOPHILUS) PAUCISPINUS sp. nov.

Belongs to the *gracilus* group, *pubipennis* subgroup; size small (wing, less than 4 millimeters); general coloration yellow; rostrum and palpi black; antennæ yellow, the terminal segment blackened; legs pale but appearing dark-colored because of the abundant vestiture; wings yellow, trichia of veins brown; male hypopygium with sparse spinules on ventromesal lobe of basistyle; both dististyles of approximately equal length, the outer one pointed at apex, with microscopic spinules on outer margin; inner style obtuse at tip, with sparse pale points at and back from apex; phallosomic plate obtuse but slightly pointed at outer end, the surface with microscopic setulæ.

Male.—Length, about 3 to 3.2 millimeters; wing, 3.8 to 4.

Rostrum and palpi black. Antennæ short, pale yellow, only the terminal segment blackened; flagellar segments oval, with very long verticils. Head pale yellow.

Pronotum yellow. Mesonotum almost uniformly dull orange yellow, the præscutum with long erect black setæ. Pleura and pleurotergite clearer yellow. Halteres pale. Legs with the coxæ and trochanters yellow; femora pale but appearing to be almost black because of abundant dark-colored setæ; outer segments darker. Wings yellow, the prearcular and costal regions clear light yellow; basal part of wing slightly more darkened; macrotrichia long and conspicuous, brown. Venation: R_2 nearly opposite r-m; petiole of cell M_3 less than twice m-cu; vein 2nd A ending about opposite m-cu.

Abdomen yellowish brown, the hypopygium deeper yellow. Male hypopygium (Plate 4, fig. 41) with the dorsal lobe of basistyle, *b*, relatively long and slender, mesal lobe about as long but very broad; ventral lobe shorter, with conspicuous yellow setæ and about 10 small blackened peglike spines. Two

subequal dististyles, *d*, the outer terminating in an acute spine, with a few microscopic appressed spinules on outer margin near apex; inner style narrowed before the obtuse tip, with a few microscopic pale points in a longitudinal row along face of style, including two at the apex. Phallosomic plate, *p*, broad, very obtusely pointed at tip, surface with abundant microscopic setulæ. Ædeagus very slender on outer third, the base with a lateral flange.

Habitat.—Japan (Honshu).

Holotype, male, Kurokawa, Echigo, August 7, 1954 (*Kintaro Baba*); Baba No. 199. Paratopotype, male.

The nearest allied regional species include *Molophilus* (*Molophilus*) *kiushiuensis* Alexander and *M.* (*M.*) *pegasus* Alexander, which are best distinguished by the details of structure of the male hypopygium, including the armature of the ventral lobe of the basistyle, and the details of both dististyles.

In addition to the type specimens of the various species, as recorded in this paper, it should be noted that additional materials of virtually all of these are preserved in the collection of Dr. Kintaro Baba, in Kurokawa, where they are arranged under his personal number, as given in conjunction with each species.

ILLUSTRATIONS

[Legend: *a*, sclerous; *b*, basistyle; *d*, dististyle; *g*, gonapophysis; *p*, phallosome; *t*, tergite.]

Plate 1

Fig. 1. *Dicranota* (*Rhaphidolabis*) *paraconsors* Alexander; venation.
2. *Pedicia* (*Tricyphona*) *tenuiloba* sp. nov.; male hypopygium.
3. *Paradelphomyia* (*Oxyrhiza*) *macracantha* sp. nov.; male hypopygium.
4. *Paradelphomyia* (*Oxyrhiza*) *macracantha* sp. nov.; venation
5. *Taiwanomyia balaella* sp. nov.; venation.
6. *Dicranota* (*Rhaphidolabis*) *paraconsors* Alexander; male hypopygium.
7. *Taiwanomyia filicornis* (Alexander); venation.
8. *Taiwanomyia fragilicornis* (Riedel); venation.
9. *Pseudolimnophila telephallus* sp. nov.; venation.
10. *Pseudolimnophila telephallus* sp. nov.; male hypopygium.
11. *Limnophila* (*Elæophila*) *kintaro* sp. nov.; male hypopygium.
12. *Limnophila* (*Elæophila*) *kintaro* sp. nov.; venation.

Plate 2

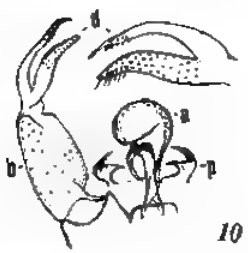
Fig. 13. *Nippolimnophila perproducta* sp. nov.; venation.
14. *Nippolimnophila perproducta* sp. nov.; male hypopygium.
15. *Cladura* (*Cladura*) *trifilosa* sp. nov.; male hypopygium.
16. *Trentepohlia* (*Mongoma*) *subpennipes* sp. nov.; venation.
17. *Cladura* (*Cladura*) *supernumeraria* sp. nov.; Venation.
18. *Cladura* (*Cladura*) *supernumeraria* sp. nov.; male hypopygium.
19. *Cladura* (*Cladura*) *itoi* Alexander; male hypopygium, lateral aspect.
20. *Cladura* (*Cladura*) *suwanoi* sp. nov.; male hypopygium.
21. *Cladura* (*Cladura*) *recurvalis* sp. nov.; male hypopygium.
22. *Cladura* (*Cladura*) *shirahatai* Alexander; male hypopygium.

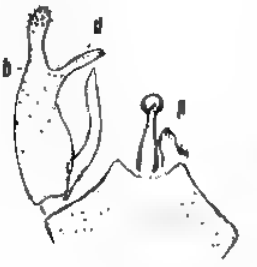
Plate 3

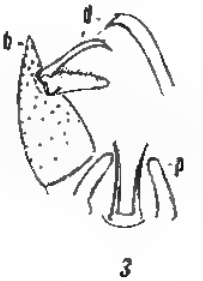
Fig. 23. *Gonomyia* (*Idiocera*) *nigrilobata* sp. nov.; venation.
24. *Gonomyia* (*Idiocera*) *nigrilobata* sp. nov.; male hypopygium.
25. *Gonomyia* (*Idiocera*) *serrulifera* sp. nov.; venation.
26. *Gonomyia* (*Gonomyia*) *gracilistylus* Alexander; venation.
27. *Gonomyia* (*Gonomyia*) *kurokawæ* sp. nov.; venation.
28. *Gonomyia* (*Gonomyia*) *necopina* sp. nov.; venation.
29. *Gonomyia* (*Idiocera*) *serrulifera* sp. nov.; male hypopygium.
30. *Gonomyia* (*Gonomyia*) *gracilistylus* Alexander; male hypopygium.
31. *Gonomyia* (*Gonomyia*) *kurokawæ* sp. nov.; male hypopygium.
32. *Gonomyia* (*Gonomyia*) *necopina* sp. nov.; male hypopygium.

PLATE 4

FIG. 33. *Lipsothrix apicifusca* sp. nov.; venation.
34. *Rhabdomastix* (*Sacandaga*) *angusticellula* sp. nov.; venation.
35. *Rhabdomastix* (*Sacandaga*) *nebulifera* sp. nov.; venation.
36. *Ormosia* (*Ormosia*) *echigoensis* sp. nov.; venation.
37. *Rhabdomastix* (*Sacandaga*) *angusticellula* sp. nov.; male hypopygium.
38. *Rhabdomastix* (*Sacandaga*) *nebulifera* sp. nov.; male hypopygium.
39. *Lipsothrix apicifusca* sp. nov.; male hypopygium.
40. *Ormosia* (*Ormosia*) *echigœnsis* sp. nov.; male hypopygium.
41. *Molophilus* (*Molophilus*) *paucispinus* sp. nov.; male hypopygium.
42. *Molophilus* (*Molophilus*) *babanus* sp. nov.; male hypopygium.
43. *Molophilus* (*Molophilus*) *perforus* sp. nov.; male hypopygium.







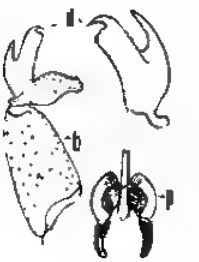
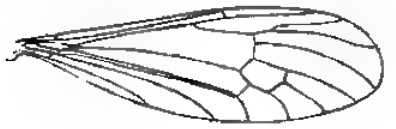


PLATE 1



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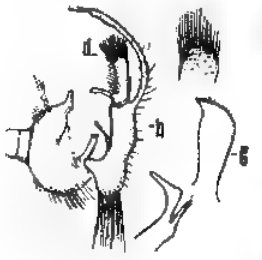

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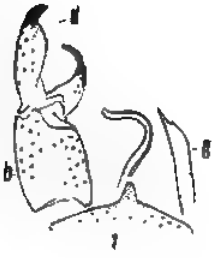

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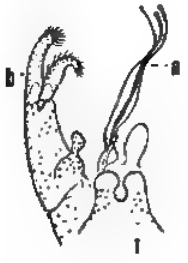

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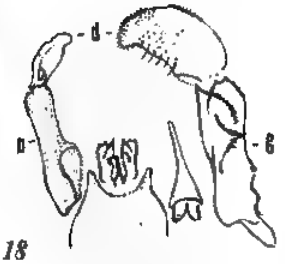

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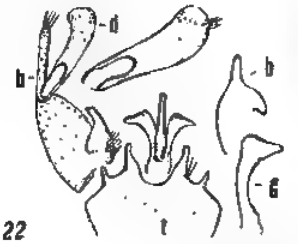

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PLATE 2.

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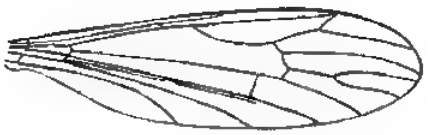

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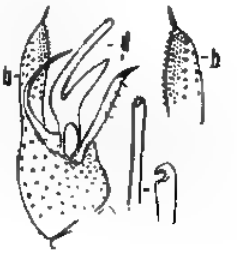

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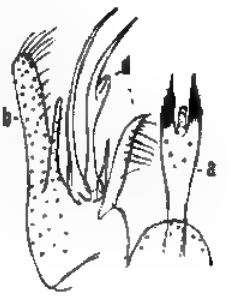

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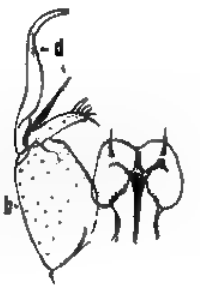

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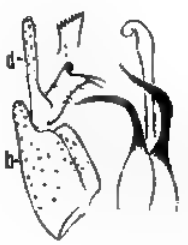

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PLATE 3.

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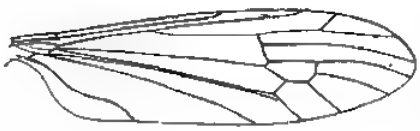

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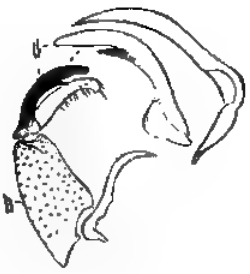

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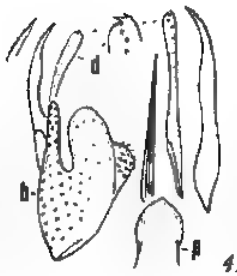

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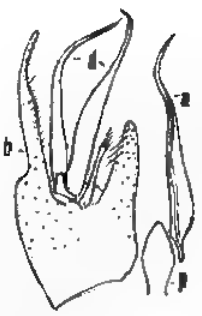

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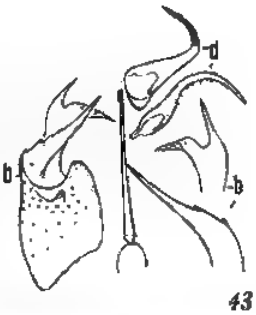

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PLATE 4.

NOTES ON ARADIDÆ FROM THE EASTERN HEMISPHERE, XI (HEMIPTERA)

ON SOME APTEROUS MEZIRINÆ FROM NEW GUINEA

By Nicolás A. Kormilev
Buenos Aires, Argentina

TWENTY TEXT FIGURES

I am greatly indebted to Dr. Eva Halaszfy, Keeper of the Department of Zoology of the Hungarian National Museum, Budapest, for the privilege to sutdy a few apterous Mezirinæ from New Guinea.

Five genera and five species treated in this paper, all new, are described. Three genera belong to the tribe Carventini Usinger, and two to the tribe Mezirini Usinger. Of the latter, one genus has armed hind femora and a stridulatory surface on the fourth sternite. The stridulatory surface are rather rare in Aradidæ, and till now were not known in the apterous forms, though, as the apterous Mezirinæ do not constitute any independent systematic group in the subfamily, we could hope to find them.

In the family Aradidæ, apterous forms have hitherto been found only in the subfamily Mezirinæ; the subfamily Aradinæ, though having the brachypterous and stenopterous forms, has none of genuine aptera; the pseudobrachypterism in Isoderminæ, as Wygodzinsky has pointed out, is of a quite different nature, and can not be regarded as brachypterism s. str.[(1946) 266].

Studying the various apterous or genera of both tribes in which they occur, Carventini and Mezirini, I was attracted by the fact that all genera belonging to the tribe Carventini which I could examine, i.e. *Glyptocoris* Harris and Drake, *Dihybogaster* Kormilev, three genera described in this paper and one genus yet in print, have the "central dorsal plate," as I name the second, middle, plate of the dorsal surface of the abdomen, composed of four tergites fused together, i. e. of the third to sixth, whereas the genera belonging to the tribe Mezirini, i. e. *Chelonocoris* Miller, *Chelysocoris* Miller, *Notoplocoris* Usinger, *Pictimus* Stål, two genera also described in this paper

and two yet in print, have this plate composed of five tergites fused together, i. e. of the second to sixth. The tribe Mezirini is more often represented by the "wingless" form than by the completely apterous, whereas the tribe Carventini is more often found apterous. Carventini have the first, and Mezirini the first and second tergites fused together, more distinctly separated from the "central dorsal plate" than from the mesonotum, with which they are often fused and difficult to separate; the first tergite in both cases does not reach laterally the outer border of the abdomen, the first connexivum always lacking, and the second produced anteriorly and limiting both the first and the second tergites. The seventh tergite is always distinctly separated from the "central dorsal plate" by a more or less deep furrow; similar furrows separate the latter also from the connexivum.

Tribe **CARVENTINI** Usinger

Genus **LIBIOCORIS** novum

Body subtriangular, rather flat, widening backwards till the 4th abdominal segment, then slightly narrowing, and terminating by two (1 + 1) big teeth, apically pointed, directed backwards and slightly divergent, situated on the seventh segment laterally. Dorsal and ventral surface partly covered with grayish incrustation, filling the depressions, and forming a curious pattern.

Head subquadrangular, almost as long as wide across eyes, anterior process slender, apically deeply notched; antenniferous spines stout, conical, apically pointed; eyes small, semiglobose, with convex faces; postocular tubercles small. Rostrum short, not reaching base of head. Antennæ slender, much longer than head and pronotum together; first and third joints subequal in length, second and fourth much shorter; first stout, second and third slender, fourth subpyriform, also slender.

Pronotum well separated from mesonotum by a curved intersegmeatal furrow; meso- and metanota separated only laterally, fused in the middle (the median ridge); metanotum fused with first and second tergites, laterally separated by furrows from connexivum. Anterior border of pronotum strongly cut out; lateral borders of notum and abdomen together forming a continuous arcuate line, more convex posteriorly; maximum width of body in both sexes across fourth abdominal segment; pronotum with a median sulcus; meso- and metanota with elevated median ridge, which also carries a slender median

furrow; pro-, meso-, and metanotum showing a curious pattern of interrupted longitudinal callous spots laterally; disks of third to sixth tergites fused into a subquandrangular central dorsal plate, scarsely elevated on median line, and with usual pattern of big and small callous spots and dots. Seventh tergite strongly elevated posteriorly (male), or only slightly (female). Hypopygium (pygophore) cordate; genital lobes of eighth segment small, subcylindrical (male), or small, dentiform (female). Spiracles placed laterally and visible from above on the second, third, sixth, and seventh segments; sublaterally on ventral surface, and not visible from above, on fourth and fifth terminal (male), or dorso-lateral (female), and visible from above on eighth (lobes).

Openings of the scent glands small, placed behind median coxæ.

Legs slender, rather long and unarmed.

Genotype.—Libiocoris pœcilus sp. nov.

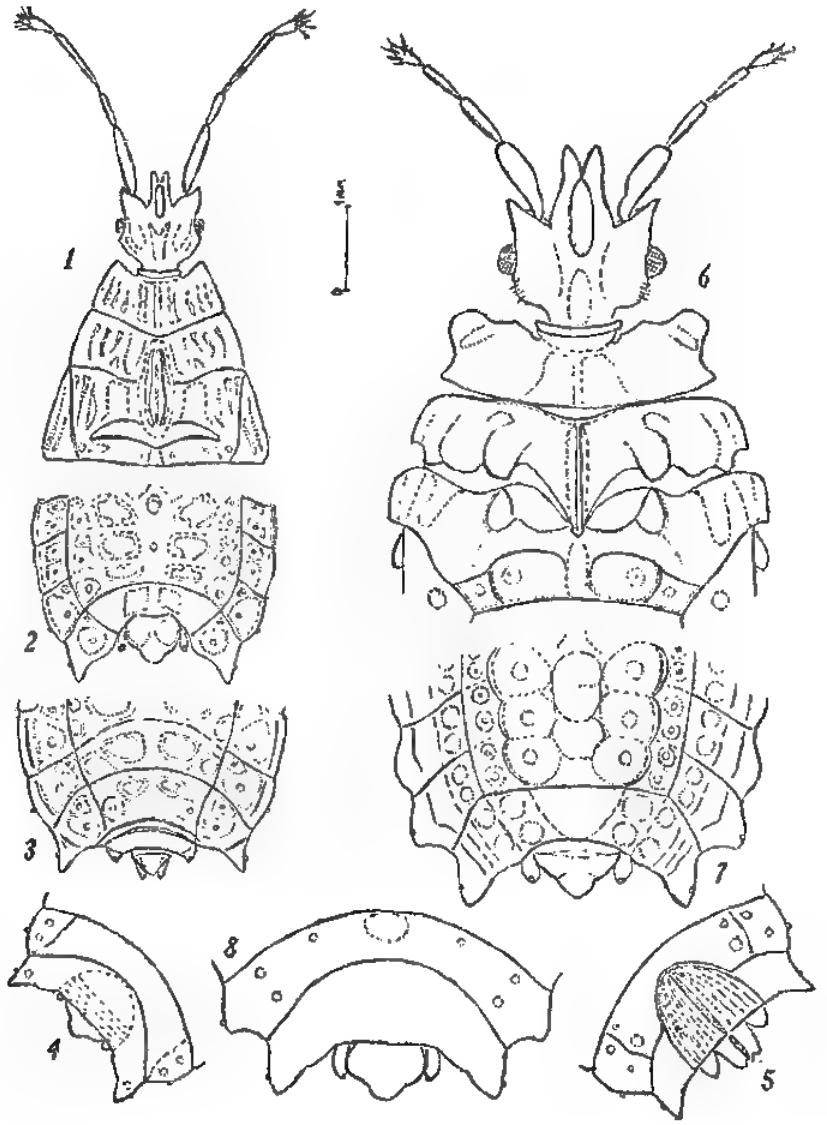
The new genus is somewhat allied to the neotropical genus *Dihybogaster* Kormilev, 1953, but differs from it by its rather flat body, strong, pointed teeth on the seventh abdominal segment, the different position of the spiracles, etc.

1. LIBIOCORIS POECILUS sp. nov.

Male, yellow-brown to testaceous, glabrous, shining; legs dirty yellowish; first three antennal joints and legs covered with a fine setigerous granulation, with a whitish, very fine and short pubescence; fourth joint apically with a brush of longer white bristles (Figs. 1-3).

Head almost as long as wide across eyes (male, 22:20; female, 22:21); tylus and vertex longitudinally elevated on median line, glabirous; two (1+1) longitudinal furrows running laterally to this elevation, filled with incrustation; anterior process with jugæ slender, parallel, distinctly projecting beyond apex of tylus, and reaching to one-fourth of first antennal joint; antenniferous tubercles stout, strongly narrowing toward apex, which is pointed, reaching to one-sixth of first antennal joint; postocular spines small, dentiform, not projecting beyond outer margin of eyes. Proportions of the antennal joint (1–4); male, 16:8:18:8:5; female, 18:8.5:18:5.9.

Pronotum subtrapezoidal, shorter on median line than wide across humeri (male, 14:31; female, 15:36); collum very small, inconspicuous; anterior angles produced forwards, apically obtuse; lateral borders almost straight; posterior border arcuated



Libiocoris poecilus gen. et sp. nov.

FIG. 1. Head and notum.
2. Apex of the abdomen, male, seen from above.
3. The same of the female.
4. Apex of the abdomen, male, seen from below.
5. The same of the female.

Euricoris occultus gen. et sp. nov.

6. Head and notum
7. Apex of the abdomen, male, seen from above.
8. The same, seen from below.

backwards; disk with a slender median sulcus and laterally to it with a pattern of longitudinal, interrupted, callous spots, interior ones bigger. Meso- and metanota widening gradually backwards, a fused longitudinal ridge in middle, slightly elevated, and laterally also a pattern of interrupted callous spots, interior ones bigger and not interrupted; first tergite almost glabrous, without incrustation; second incrustated only laterally; the central dorsal plate (third to sixth tergites) scarsely elevated on median line, which is interrupted on fourth tergite by a small, round, callous spot; four (2 + 2) longitudinal rows of callous spots and dots running laterally to median line: two interior composed of one big spot on each segment, exterior of one spot and one dot on each segment; similar spots and dots placed also on connexiva and disk of seventh tergite, as on ventral surface of abdomen. Lateral borders of body from mesonotum till seventh connexivum continuous, without projection; teeth of seventh connexiva long, stout, apically pointed, projecting far beyond apex of hypopygium (male) or reaching apex of ninth segment (female). Eighth segment (female) wide and short, posteriorly slightly cut out; ninth projecting backwards, its apex cut out, genital valves slightly longer than oviduct. (Figs. 4 and 5).

Total length: male, 4.1; female, 4.75 mm; width of pronotum: male, 1.1; female, 1.3 mm; width of abdomen: male, 1.9; female, 2.4 mm.

Holotype.—Male, New Guinea, Huon, Gulf, Sattelberg—Biró coll. 1899; deposited in the Hungarian National Museum, Budapest.

Allotype.—Female, collected with the holotype, in the same collection. One nymph of the fourth instar in the same collection.

Genus EURICORIS novum

Body without the head subrectangular; thickly covered with grayish incrustation, shiny beneath incrustation and with few erect, short bristles.

Head almost as long as wide across eyes; anterior process stout, parallel, anteriorly forked, not reaching tip of first antennal joint; antenniferous spines stout, big, dentiform, apically pointed, divergent; eyes small, semiglobose, protruding; postocular borders rounded, unarmed; vertex with a median ridge. Antennæ slender, shorter than head and pronotum combined; first joint stout, clavate; second and third slender, shorter than first, slightly narrowing toward base; fourth small, pyriform. Rostrum reaching hind border of rostral groove.

Pronotum transversal, much shorter than wide; collum slender, laterally separated by deep cuts; antero-lateral angles rounded, lobulated; postero-lateral angles dentiform, protruding outwards, lateral border between them roundly cut out; disk with a median T-form furrow, laterally uneven, with a few furrows and small elevations.

Mesonotum also transversal, separated from pronotum by a deep, transversal furrow, and from metanotum with two (1+1) lateral, transversal furrows; produced backwards posteriorly in middle and fused with first tergite; disk a cordiform plate in the middle, shallowly depressed on median line; laterally to this plate with two (1+1) big longitudinal ridges, somewhat protruding backwards; exteriorly to them uneven and rimmed along lateral borders.

Metanotum divided into two (1+1) big, semicircular plates, interiorly inflated, exteriorly flat, uneven; inflated parts each with a thin longitudinal furrow; exterior borders rimmed.

Abdomen as long as wide, divided into three plates, separated from each other from connexivum by deep furrows; fore plate formed by first and second tergites, which are fused together in the middle and depressed on median line, laterally separated by fine transversal sulci; first tergite plane; second laterally to the median depression with four (2+2) round depressions, so characteristic for the Aradidæ. Central dorsal plate formed by third to sixth tergites fused togeher; slightly elevated on median line and laterally provided with four (2+2) rows of inner, bigger, and outer, smaller, rounded depressions; outer border of inner depressions carinated. Third plate formed by seventh tergite, which is posteriorly elevated in middle and laterally flat; connexiva flat; their exterior boarder slightly convex on third and fourth, more convex on fifth; rectangularly protruding on sixth, and dentiform, produced backwards on seventh; inner border of connexiva each with two longitudinally disposed, round depressions; hypopygium (pygophore) caudal in position, subpyriform; lobes of eighth (male) very small. Spiracles ventral, placed far from lateral border on second, sublateral, but not visible from above on third and fourth, lateral and visible from above on fifth to seventh, and on lobes (eight). Scent gland openings concealed behind median coxæ. Legs unarmed.

Genotype.—Euricoris occultus sp. nov.

The new genus also belongs to the tribe Carventini Usinger, and is somewhat allied to the genus *Chelonoderus* Usinger, 1941, but differs by the head not so narrowed posteriorly; pronotum with lobulated antero-lateral angles, and dentiform posterolateral; the pattern of the notum and tergum being different, etc.

2. EURICORIS OCCULTUS sp. nov.

Male chestnut brown, shiny, but the actual color is completely concealed by a thick grayish incrustation.

Head longer than wide across eyes (42:37); anterior process reaching to five-sixths of the first antennal joint; antenniferous spines reaching to two-fifths of first antennal joint; proportions of antennal joints (1–4) 18:13:12:8. (Fig. 6).

Pronotum one-third as long as wide (20:60); mesonotum about two-fifths as long as wide (28:70); with length measured from fore boarder of first tergite to the tip of the hypopygium (figs. 7 and 8); abdomen as long as wide across fourth segment (86:86).

Male, total length, 6.5 mm; width of the pronotum, 2.25 mm; width of abdomen, 3.1 mm.

Holotype.—Male, New Guinea, Astrolabe Bay, Stephansort, Biró coll., 1900; deposited in the Hungarian National Museum, Budapest.

Genus BIROANA novum

Small, ovate; tergum elevated on median line, more so in female; antennæ short and slender; body covered with dense, concolorous, punctation, dispersed, short, erect, bristles, and a fine coat of a brownish incrustation.

Head transverse; anterior process stout, convergent forwards, and anteriorly notched, not reaching tip of first antennal joint; clypeus relatively long, posteriorly running far into vertex; laterally to it, head flat and lobulated; antenniferous spines dentiform strongly divergent, not reaching middle of first antennal joint; eyes small, with convex facets; postocular borders strongly convex, rounded, unarmed. Antennæ short, slightly longer than head, slender; first joint robust and clavate, second much shorter and much slenderer, ovate; third subequal to second, slightly widening towards tip; fourth subequal in length to second and third together, fusiform, slightly shorter than first. Rostrum short, reaching to hind border of rostal groove.

Pronotum transverse, about one-third as long as wide; collum tiny, almost imperceptible; antero-lateral borders, laterally to latter, slightly sinuate; antero-lateral angles slightly produced and terminating in a small tooth or tubercle; lateral borders almost straight, posterior convex, rounded; lateral borders of body provided with small granulation and with short, erect bristles between granulæ; disk of pronotum showing a tiny median sulcus.

Mesonotum transverse, much wider than long, posteriorly produced backwards and elevated, reaching to first tergite; disk with a fine median sulcus, produced across first tergite.

Metanotum divided into two (1+1) big plates, separated from each other by posterior process of mesonotum; each plate in middle roundly inflated.

Abdomen almost as long as wide, divided by two transverse, deep furrows into three separate plates, and separated from connexivum also by deep furrows. The first plate formed by first and second tergites, second by third to sixth, and third by seventh tergite. The first tergite laterally reaching connexivum of the second segment, elevated on median line, and declivous forwards, anteriorly fused with the meso- and metanotum, respectively; second tergite separated from first by a fine transverse sulcus, and from central dorsal plate by a much deeper sulcus; also inflated on median line and declivous forwards; central dorsal plate deeply sinuate posteriorly in male, subrectangular in female; elevated on median line, more so in female, and laterally provided with four (2+2) rows of round callous spots or depressions; median ridge declivous backwards on third, raised from fourth to fifth, and declivous backwards on sixth tergite; seventh tergite raised backwards in middle in male for reception of the hypopygium, and flat in female; connexivum interiorly with a row of round, callous spots, and with a fine longitudinal carina exteriorly; lobes of eighth very small; hypopygium of male caudal in position, ovate as seen from behind. Spiracles lateral and visible from above on second to seventh segments, terminal on lobes (eighth); scent gland openings concealed behind median coxæ legs unarmed.

Genotype: Biroana eurycephala sp. nov.

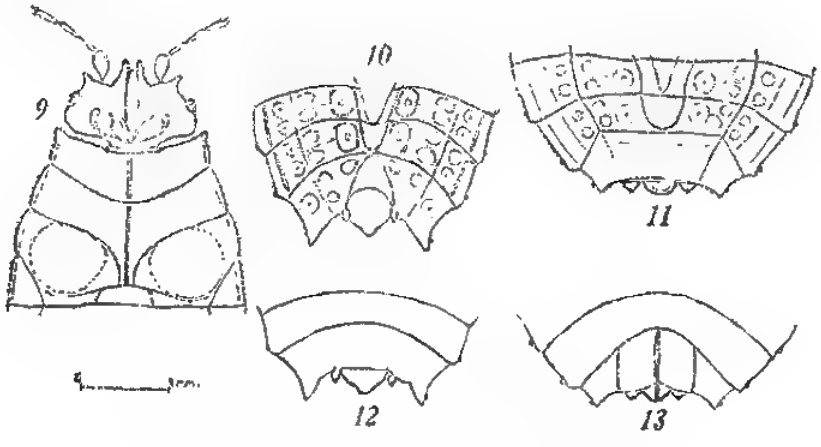
The new genus is isolated in the family Aradidæ, particularly in the transverse, laterally lobulated head, which is not known in this family.

The genus is dedicated to the late Dr. Biró, who collected so many striking Aradidæ in New Guinea.

3. BIROANA EURYCEPHALA sp. nov.

Male, testaceous; antennæ, rostrum and legs ocraceous, but the actual color is completely concealed by a thin coat of the brownish incrustation.

The measures: head wider than long across eyes (male, 19:28; female, 19:28); proportions of antennal joints (1–4): male, 8:3:4:6; female, 9:3:5:8; anterior process reaching to three-fourths of first antennal joint; antenniferous spines reaching to two-fifths of first antennal joint; vertex behind clypeus provided with a V-shaped median sulcus, and laterally to it with four (2+2) fine, curved sulci; pronotum wider than long (male, 12:41; female, 12:45); mesonotum also wider than long (male, 10:36; female, 11:38); abdomen almost as long as wide (male, 51:50; female, 57:60). (Figs. 9–13).



Biroana curycephala gen. et sp. nov.

FIG. 9. Head and notum.
10. Apex of the abdomen, male, seen from above.
11. The same of the female.
12. Apex of the abdomen, male, seen from below.
13. The same of the female.

Total length: male, 3.4; female, 3.7 mm; width of the pronotum: male, 1.3; female, 1.4 mm; width of the abdomen: male, 1.8; female, 2.1 mm.

Holotype.—Male, New Guinea, Huon Golf, Sattelberg—Biró coll., 1899; deposited in the Hungarian National Museum, Budapest.

Allotype.—Female, collected with the holotype; in the same collection.

Paratypes.—Seven males, three females, and one nympha, collected with the holotype; one male, New Guinea, Astrolabe Bay, Stephansort—Biró coll., 1900; in the same collection and in the collection of the author.

Tribe MEZIRINI Usinger

Genus CÆCICORIS novum

Ovate, anteriorly narrowed; the dorsal surface of the body provided with various tubercles, carinæ and elevations, which are covered with long, curled, or short, erect bristles; first antennal joint and femora also covered with long, curled hairs; ventral surface of body, second antennal joint and the tibiæ covered with short, erect bristles; entire body, with the exception of third and fourth antennal joints and legs, covered with brown incrustation.

Head longer than wide across eyes; anterior process robust, strongly convergent forwards and apically cut out, distinctly shorter than first antennal joint; antenniferous spines stout, dentiform, divergent; eyes small, semiglobose, protruding; postocular borders convergent backwards, almost straight, unarmed; vertex with a stout median ridge. Antennæ longer than head and pronotum together; first joint robust, clavate; second slender and much shorter, narrowing towards base; third the longest, slightly narrowing towards base; fourth pyriform, longer than second, but shorter than first. Rostrum short, reaching hind border of rostral groove.

Pronotum much wider than long, divided by a deep, curved, transverse furrow into two lobes; fore lobe bigger and higher; anterior border deeply and widely cut out; collum lacking; anterolateral angles produced forwards as rounded lobes and projected outwards as a transverse tooth; lateral borders behind tooth deeply and roundly cut out, then projecting outwards as a second tooth, somewhat bigger; behind latter slightly cut out and then elevated in a lateral, longitudinal ridge, slightly protruding outwards; hind border of pronotum almost straight, slightly cut out in middle; fore disk provided with two (1+1) big and high tubercles; transverse furrow, separating lobes, running in a straight line from second cut of the lateral border towards middle of hind border, but not reaching it and turning towards middle cut of opposite border; hind lobe with a median depression.

Mesonotum highly inflated in middle in the shape of a "scutellum"; laterally on each side, behind posterolateral angles of

Paratypes.—Seven males, three females, and one nympha, collected with the holotype; one male, New Guinea, Astrolabe Bay, Stephansort—Biró coll., 1900; in the same collection and in the collection of the author.

Tribe MEZIRINI Usinger

Genus CÆCICORIS novum

Ovate, anteriorly narrowed; the dorsal surface of the body provided with various tubercles, carinæ and elevations, which are covered with long, curled, or short, erect bristles; first antennal joint and femora also covered with long, curled hairs; ventral surface of body, second antennal joint and the tibiæ covered with short, erect bristles; entire body, with the exception of third and fourth antennal joints and legs, covered with brown incrustation.

Head longer than wide across eyes; anterior process robust, strongly convergent forwards and apically cut out, distinctly shorter than first antennal joint; antenniferous spines stout, dentiform, divergent; eyes small, semiglobose, protruding; postocular borders convergent backwards, almost straight, unarmed; vertex with a stout median ridge. Antennæ longer than head and pronotum together; first joint robust, clavate; second slender and much shorter, narrowing towards base; third the longest, slightly narrowing towards base; fourth pyriform, longer than second, but shorter than first. Rostrum short, reaching hind border of rostral groove.

Pronotum much wider than long, divided by a deep, curved, transverse furrow into two lobes; fore lobe bigger and higher; anterior border deeply and widely cut out; collum lacking; anterolateral angles produced forwards as rounded lobes and projected outwards as a transverse tooth; lateral borders behind tooth deeply and roundly cut out, then projecting outwards as a second tooth, somewhat bigger; behind latter slightly cut out and then elevated in a lateral, longitudinal ridge, slightly protruding outwards; hind border of pronotum almost straight, slightly cut out in middle; fore disk provided with two (1+1) big and high tubercles; transverse furrow, separating lobes, running in a straight line from second cut of the lateral border towards middle of hind border, but not reaching it and turning towards middle cut of opposite border; hind lobe with a median depression.

Mesonotum highly inflated in middle in the shape of a "scutellum"; laterally on each side, behind posterolateral angles of

pronotum, provided with a small, flat, rounded, scalelike sclerite—extremely reduced wing-pads, which can be easily separated from body; tip of "scutellum" reaching first tergite.

Metanotum divided into two separate, big plates, elevated along hind border, and roughly punctated before this elevation.

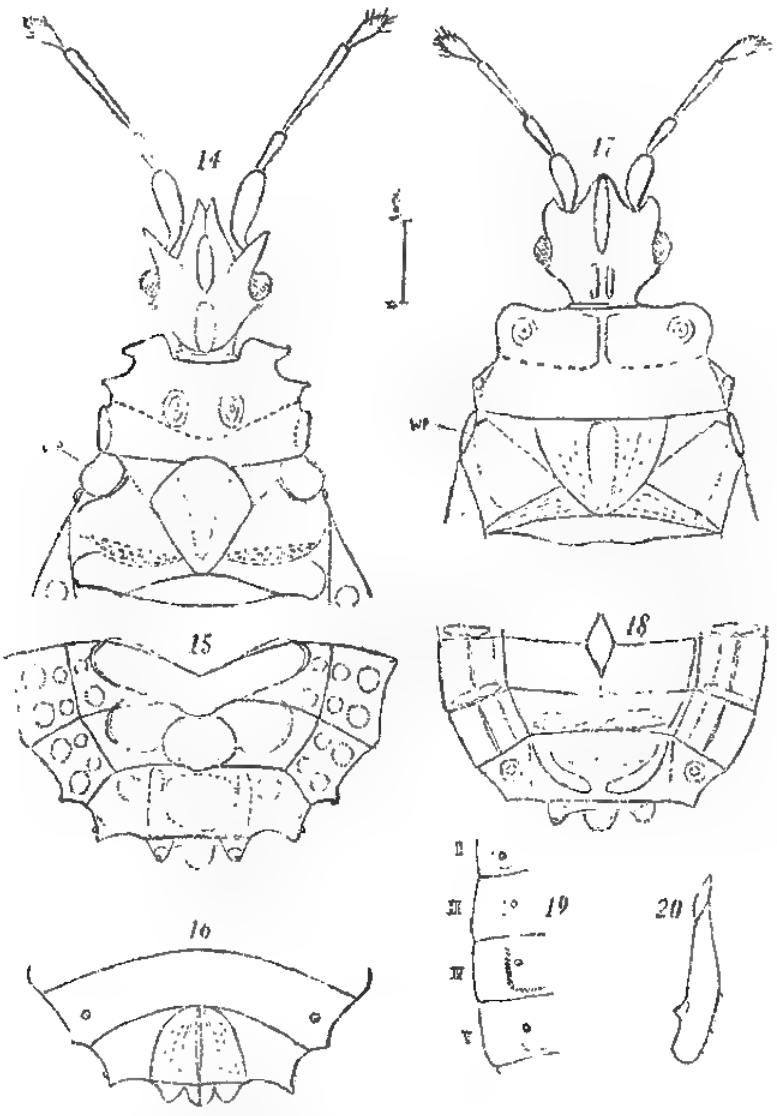
Abdomen longer than wide; divided into three plates; first plate consisting of first tergite; second, or central dorsal plate, consisting of second to sixth tergites, and third of seventh tergite. Frist tergite scabrous, declivous forwards, laterally reaching to connexivum of second segment, posteriorly separated from central dorsal plate by a fine, transverse furrow. Central dorsal plate separated laterally from connexivum and posteri orly from seventh tergite, by fine, but deep furrows; disk declivous forwards anteriorly (second tergite), then with a high-transverse ridge (third tergite), which is stouter in middle and produced backwards on median line across the fourth and fifth tergites in the form of a scale; lateral borders of fourth to sixth tergites raised, and hind border of sixth provided with a big, transverse ovate, median elevation; between transverse ridge of third tergite and posterior border of sixth are situated six (3+3) slightly oblique depressions. Lateral borders of adbomen strongly convex, rounded, but exterior border of each segment slightly sinuate, more so on seventh; inner border of second and hind border of third to sixth connexiva elevated as a carina or ridge; ectocaudal angles of sixth rectangular and slightly protruding, those of seventh dentiform, directed upwards and backwards; lobes of eighth (female) also dentiform and directed upwards; ninth distinctly projecting backwards between lobes and rounded, genital valves a little shorter than oviduct. Scent gland openings big, slightly curved, placed beneath wing-pads, and visible from above. Spiracles big, those of second to sixth segments ventral, placed far from lateral border, those of seventh and of lobes (eighth) lateral and visible from above. Legs unarmed.

Genotype.—Cæcicoris oviventris sp. nov.

The new genus is not closely allied to any known genus of Mezirinæ. The head is somewhat similar to that of *Artabanus* Stål. but the notum and abdomen are quite different.

4. CÆCICORIS OVIVENTRIS sp. nov.

Female, brown; antennæ, rostrum, and legs pale yellowish brown to ochraceous; covered with brown incrustation concealing actual color of body.



Cæcicoris oviventris gen. et sp. nov.

FIG. 14. Head and notum.
15. Apex of the abdomen, female, see from above.
16. The same, seen from below.

Scironocoris armigerus gen. et sp. nov.

17. Head and notum.
18. Apex of the abdomen, female, seen from above.
19. The middle of the lateral border of the venter with stridulatory apparatus on the fourth sternite.
20. Hind femor with the toothed.

Head longer than wide across eyes (36:31); proportions of antennal joints (1–4) 17:10:25:12; anterior process reaching to two-thirds and antenniferous spines to one-third of first antennal joint; pronotum about two-fifths as long as wide (20:51); mesonotum transverse, much shorter than wide (22:55); abdomen longer than wide (89:86) (Figs. 14–16).

Female, total length, 6.25 mm; width of pronotum, 1.8 mm; width of abdomen, 3.2 mm.

Holotype.—Female, New Guinea, Huon Golf, Sattelberg—Biró coll., 1899; deposited in the Hungarian National Museum, Budapest.

Genus SCIRONOCORIS novum

Elongately-ovate, coarsely granulated on pro- and mesonota, less so on head and first two antennal joints, roughly punctated on tergum; covered sparsely with dispersed, very short, erect bristles and with a sticky incrustation, accumulating dirt.

Head almost as long as wide across eyes; anterior process robust, convergent and anteriorly rounded, without notch, shorter than first antennal joint; antenniferous spines robust, curved, directed forwards; eyes moderately big, semiglobose, protruding; postocular borders slightly concave, unarmed; vertex with two (1+1) parallel, longitudinal carinæ. Antennæ shorter than head and pronotum together; first joint robust, clavate; second slender and shorter, regularly narrowing towards base; fourth pyriform. Rostrum short, reaching hind border of head, rostral groove open posteriorly.

Pronotum twice as wide as long, divided into two lobes by a deep, transverse depression; collum small; anterior border truncated; antero-lateral angles slightly expanded and rounded; lateral borders angularly notched in middle; posterior border of pronotum almost straight; fore disk scabrous, roughly granulated and deeply punctate, provided with a deep median furrow, and two (1+1) lateral, high, rounded, tubercles; hind disk widely declivous anteriorly, with two (1+1) rectangular, erect, stout, ridges laterally.

Mesonotum inflated in middle in the shape of a big "scutellum," the latter provided with median ridge; laterally to "scutellum" flat. At lateral borders, behind postero-lateral angles of pronotum, two (1+1) elongated, ridgelike sclerites, placed vertically—the extremely reduced wing-pads.

Head longer than wide across eyes (36:31); proportions of antennal joints (1–4) 17:10:25:12; anterior process reaching to two-thirds and antenniferous spines to one-third of first antennal joint; pronotum about two-fifths as long as wide (20:51); mesonotum transverse, much shorter than wide (22:55); abdomen longer than wide (89:86) (Figs. 14–16).

Female, total length, 6.25 mm; width of pronotum, 1.8 mm; width of abdomen, 3.2 mm.

Holotype.—Female, New Guinea, Huon Golf, Sattelberg—Biró coll., 1899; deposited in the Hungarian National Museum, Budapest.

Genus SCIRONOCORIS novum

Elongately-ovate, coarsely granulated on pro- and mesonota, less so on head and first two antennal joints, roughly punctated on tergum; covered sparsely with dispersed, very short, erect bristles and with a sticky incrustation, accoumulating dirt.

Head almost as long as wide across eyes; anterior process robust, convergent and anteriorly rounded, without notch, shorter than first antennal joint; antenniferous spines robust, curved, directed forwards; eyes moderately big, semiglobose, protruding; postocular borders slightly concave, unarmed; vertex with two (1+1) parallel, longitudinal carinæ. Antennæ shorter than head and pronotum together; first joint robust, clavate; second slender and shorter, regularly narrowing towards base; fourth pyriform. Rostrum short, reaching hind border of head, rostral groove open posteriorly.

Pronotum twice as wide as long, divided into two lobes by a deep, transverse depression; collum small; anterior border truncated; antero-lateral angles slightly expanded and rounded; lateral borders angularly notched in middle; posterior border of pronotum almost straight; fore disk scabrous, roughly granulated and deeply punctate, provided with a deep median furrow, and two (1+1) lateral, high, rounded, tubercles; hind disk widely declivous anteriorly, with two (1+1) rectangular, erect, stout, ridges laterally.

Mesonotum inflated in middle in the shape of a big "scutellum," the latter provided with median ridge; laterally to "scutellum" flat. At lateral borders, behind postero-lateral angles of pronotum, two (1+1) elongated, ridgelike sclerites, placed vertically—the extremely reduced wing-pads.

Metanotum transverse, separated in middle by "scutellum" into two (1+1) independent, rhomboid plates, which are scabrous, granulated and deeply punctate.

Abdomen longer than wide, rather flat, divided into three plates: first plate consisting of first tergite, second, or central dorsal plate, consisting of second to sixth tergites, and third of seventh tergite. First tergite split in middle into two (1+1) plates, separated by tip of "scutellum." Tergites fused together in central dorsal plate, the limits between them indicated only by thin transverse carinæ; a thin median carina across plate, dilated in a rhomboid on limit between fourth and fifth tergites; disk of plate roughly punctate, but without granulation; rhomboid glabrous, without punctation. Lateral borders of the abdomen slightly and evenly convex; ectocaudal angles of connexiva not protruding; disks of connexiva each with a thin longitudinal and stout transverse carina, the latter placed along hind border of segments. Seventh tergite laterally and posteriorly elevated in the form of a semicircular ridge, interrupted in middle. Scent gland openings big, curved, placed beneath wing-pads, and not visible from above. Spiracles big, ventral, and placed far from lateral border on second to seventh segments, terminal on lobes (the eigth); lobes (female) triangular, shorter than ninth, the latter apically rounded. Fourth sternite provided with a stridulatory apparatus in the form of a rectangular, granulated carina, running exteriorly and posteriorly to spiracle (Figs. 19–20), its counterpart in the form of a big tooth on nether surface near apex of hind femora. Fore and middle femora unarmed.

Genotype.—Scironocoris armigerus sp. nov.

The new genus is somewhat allied to the genus *Artabanus* Stål, 1865, but differs from it by the shape of the pronotum, by the spiracles of the seventh segment being ventral, placed far from the lateral margin, by a curiously shaped stridulatory apparatus on the fourth sternite, etc.

5. SCIRONOCORIS ARMIGERUS sp. nov.

Female; dark reddish brown to piceous; eyes, base of first and apical half of fourth antennal joints, rostrum, rhomboid glabrous spot of tergum, and tarsi, yellow-brown.

Head almost as long as wide across eyes (30:31); proportions of antennal joints (1–4); 13:10; 16:11; anterior process reaching three-fifths and antenniferous spines one-fourth of first antennal joint; pronotum twice as wide as long (27:55);

mesonotum less than half as long as wide (25:63); abdomen longer than wide (80:73). (Figs. 17–18).

Female, total length, 5.8 mm; width of the pronotum, 2.1 mm; width of the abdomen, 2.8 mm.

Holotype.—Female, New Guinea, Friedrich-Wilhelmshafen—Biró coll., 1896 [1] deposited in the Hungarian National Museum, Budapest.

Note. The third genus described in this paper is dedicated to Dr. Biró, as I stated previously, all others are dedicated to the gods of the winds: Libs, the wind of SW; Cæcias, the wind of NW; Euros, the wind of SE; and Sciron, the wind of NE.

REFERENCE

WYGODZINSKY, P. Contribution towards the knowledge of the Isoderminæ (Aradidæ, Hemiptera). Rev. Ent. Rio de Jan. (1–2) 17 (1946) 266–273.

[1] All the locality names in this paper are indicated as they are on the original labels of the Biró collection.

NEW APTEROUS ARADIDS FROM THE EAST INDIES (HEMIPTERA)

By Carl J. Drake
Ames, Iowa, U.S.A.

TWO TEXT FIGURES

This paper describes three new genera and three new species of apterous Aradidæ (subfamily Mezirinæ) from the East Indies and one new species from Malaya. The types have been deposited as stated under the specific descriptions. In the structural measurements, 80 units equal one millimeter.

Genus ZOROAPTERA novum

Obovate or oblong, depressed above, without high elevation, deep depressions or lateral lobes; tylus and juga subequally extended in front, or juga slightly surpassing the tylus as short, fingerlike projections; lateral shelves thick, each slightly wider than median longitudinal part of head, with superior surfaces of shelves and median part of head on practically the same horizontal level; eyes small, rounded, feebly stalked, placed on outer sides of lateral shelves slightly in front of middle, slowly narrowed behind eyes to neck, with a protuberance just back of each eye. Labial sulcus short, not quite reaching to neck; labium short, scarcely attaining apex of sulcus. Antennæ moderately long, granulate, reaching slightly beyond base of pronotum; segment I incrassate, extending three-fourths of its length beyond tylus and juga; IV subclavate. Legs slender, moderately long.

Pronotum much wider in front than width across eyes, deeply widely excised at middle for reception of collar; pro-, meso-, and metanota and abdominal tergites I and II fused into one piece, with sutures in front of and behind mesonotum represented by prominent furrows, with posterior margin of fused tergite deeply widely obtusely angulately or subroundly excised. Abdominal tergites III to V (inclusive) conjointly fused, truncate behind, subroundly or obtusely angulately extended in front, with a complicated pattern of shallow impressions bounded by low narrow ridges on each side of median longitudinal line; tergite VII segmented from VI by a transverse suture; con-

nexival segments set apart from one another and from abdominal tergites by visible sutures, except I, II, and III joined together.

Spiracles II to VII placed up on top of small, rounded elevations; II and III ventral, the former farther removed from outer edge than latter, neither visible from above; IV to VII (inclusive) lateral and VIII placed on apical end of posterolateral projections, all of which are plainly visible from dorsal aspect. Thorax and abdomen above with many small, dimplelike indentations in impressed areas that glitter or sparkle in bright light, the large impressed areas on abdominal tergites encircled within by closely set rows of dimpled indentations which glitter under lamp of microscope.

Type species, *Zoroaptera bonahana* sp. nov.

This genus is distinguished from other genera described herein by the position of abdominal spiracles, fusion of all three thoracic divisions and first two abdominal tergites into a single unit, deeply widely excavated anterior margin of pronotum for reception of collar, feebly stalked eyes, deeply excised posterior margin of tergite II and the triangularly produced basal margin of tergite III.

ZOROAPTERA BONAHANA sp. nov.

Large, obovate, dark ferrugineous. Head subtriangular, narrowed behind eyes, rugulose, much shorter across eyes than median length (80:112); eyes reddish, feebly stalked, with a low rounded tubercle just back of each eye; antenniferous tubercles very stout, divergent, each terminating in a slender rounded projection; tylus thick, broad, with dorsal surface arched apically; juga thin, compressed laterally, with narrow dorsal edge much lower than that of dorsal surface of tylus, each jugum extending beyond tylus in form of short fingerlike projection, which is straight and not as long as width of tylus. Antennal measurements: I, 54; II, 32; III, 46; IV, 24. Labial sulcus short, the labium scarcely attaining apex of sulcus.

Body with lateral margins densely granulate, the granules arranged largely in rows. Fused thoracic division and abdominal tergites I and II with an uninterrupted median longitudinal furrow extending from collar to posterior margin of tergite II; base of abdominal tergite II very widely deeply triangularly excavated. Abdomen with the basal margin of fused tergites (III to VI) obtusely angulate, with apex of triangle extended anteriorly as a short, fingerlike projection; impressed area of tergites and thorax decorated with many dimpled indentations;

connexival segments strongly granulate, each with two, small, rounded, smooth, slightly raised discal areas in each segment. Body beneath moderately convex.

Length, 6.50 mm; width, 2.80 mm.

Holotype (female), Mt. Banahao, Philippines, Drake Collection.

Separated from its congener described below by the juga surpassing tylus, measurements of antennal segments, rounded protuberances back of eyes and the long, narrow, deep, median, longitudinal, unbroken furrow of thorax.

ZOROAPTERA MALAISEI sp. nov. Fig. 1.

Large, obovate, dark ferrugineous. Head subtriangular, rugulose, slowly narrowed behind eyes, with a short, arched, longitudinal ridge back of each eye, width across eyes shorter than median longitudinal length (85:105); juga flat, not surpassing tylus, with upper edge much lower than dorsal surface of tylus antenniferous tubercules stout, divergent, tapering to a blunt point; median longitudinal part of head slowly arched behind the eyes and with a row of five or six small cavities on median line. Antennal measurements: I, 68; II, 48; III, 42; IV, 30. Labial sulcus wide, not very deep, not reaching to neck; labium testaceous, shorter than sulcus. Spiracles located as stated in generic description.

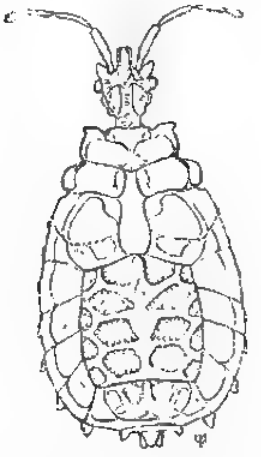


FIG. 1. *Zoroaptera malaisei* sp. nov., type.

Pronotum narrower than mesonotum, four times as wide at base as median length (excluding collar); collar smooth, with an encircling median furrow, with a small tubercle on each side opposite a similar tubercle projecting from the extended outer part of pronotum. Fused three division of thorax and tergites I and II with a very wide, low, smooth, median longitudinal ridge (tapering anteriorly) extending uninterruptedly from apex of pronotum to posterior end of tergite II; base of tergite II obtusely angulately excised; pronotum furrowed on median longitudinal line. Abdominal tergites (III to VI) fused, quadrate, with a tumid area in front of basal angle, median

connexival segments strongly granulate, each with two, small, rounded, smooth, slightly raised discal areas in each segment. Body beneath moderately convex.

Length, 6.50 mm; width, 2.80 mm.

Holotype (female), Mt. Banahao, Philippines, Drake Collection.

Separated from its congener described below by the juga surpassing tylus, measurements of antennal segments, rounded protuberances back of eyes and the long, narrow, deep, median, longitudinal, unbroken furrow of thorax.

ZOROAPTERA MALAISEI sp. nov. Fig. 1.

Large, obovate, dark ferrugineous. Head subtriangular, rugulose, slowly narrowed behind eyes, with a short, arched, longitudinal ridge back of each eye, width across eyes shorter than median longitudinal length (85:105); juga flat, not surpassing tylus, with upper edge much lower than dorsal surface of tylus antenniferous tubercules stout, divergent, tapering to a blunt point; median longitudinal part of head slowly arched behind the eyes and with a row of five or six small cavities on median line. Antennal measurements: I, 68; II, 48; III, 42; IV, 30. Labial sulcus wide, not very deep, not reaching to neck; labium testaceous, shorter than sulcus. Spiracles located as stated in generic description.

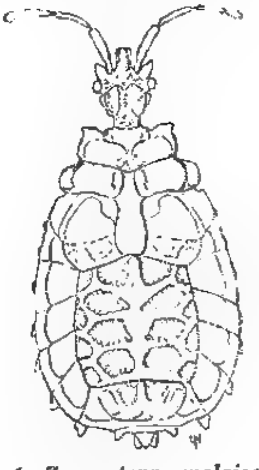


FIG. 1. *Zoroaptera malaisei* sp. nov., type.

Pronotum narrower than mesonotum, four times as wide at base as median length (excluding collar); collar smooth, with an encircling median furrow, with a small tubercle on each side opposite a similar tubercle projecting from the extended outer part of pronotum. Fused three division of thorax and tergites I and II with a very wide, low, smooth, median longitudinal ridge (tapering anteriorly) extending uninterruptedly from apex of pronotum to posterior end of tergite II; base of tergite II obtusely angulately excised; pronotum furrowed on median longitudinal line. Abdominal tergites (III to VI) fused, quadrate, with a tumid area in front of basal angle, median

longitudinal ridge, low, wide, and smooth. Thorax and tergites with sculpturing arranged in a somewhat similar pattern as in *Z. bonahana*.

Length, 6.25 mm; width, 3.25 mm.

Holotype (female), Northeast Burma (Kambaiti), June 6, 1934, Dr. Rena Malaise, in Naturhistouska Riksmuseum, Stockholm, Sweden. Named in honor of the noted entomologist, Dr. Malaise, who is in charge of the insect collection in the Stockholm museum.

Distinguished from *Z. bonahana* by the very wide, low, smooth, uninterrupted median ridge of thorax, shorter head and length of antennal segments.

Genus APTERARADUS novum

Body oblong, widest behind middle of abdomen, depressed above and without tumid areas and cavities, moderately convex beneath; abdomen without lateral lobes and projections; pronotum and mesonotum with very small projections (one on each side). Spiracles II to V (inclusive) ventral, each placed progressively auteriorly slightly farther from outer edge of connexivum; VI and VII (lateral) and VIII (posterior, genital) plainly visible from dorsal aspect; II to VII placed up on top of small rounded projections, VIII on apex of a posterolateral tubercle. Orifice present. Legs slender, finely granulate.

Head slender, long, especially postocular part, subquadrate in front of eyes, postocular part practically twice the length of anteocular; eyes large, rounded, with base feebly inserted, placed on outer side of lateral shelves, sharply narrowed behind eyes to neck; lateral shelves thick, short, with dorsal surface slightly lower than that of median longitudinal part of head; juga fairly thick, with dorsal surface a little lower than that of tylus, with apices slightly surpassing tylus and turned inward so as to meet at midline in front of tylus. Labial sulcus short, not reaching to neck, labium not attaining apex of sulcus. Antennæ scarcely longer than head; segment I incrassate, bent outward; III slenderest, longest; IV subclavate. Neck long.

Pronotum much wider than head across eyes, wider than mesonotum, distinctly obtusely angulate behind, with a narrow, smooth, rounded ridge running along the edge of posterior border; mesonotum separated from both pronotum and metanotum by transverse furrows (not functional sutures), with a fairly large posterior, triangular (equilateral) projection (not a scutellum) with apex extending almost to base of metanotum,

with flat smooth median ridge (tapering behind) extending from anterior margin almost to apex of triangular projection. Pro-, meso-, and metanota and abdominal tergites conjointly fused, the sculpturing on tergite II of a similar pattern as on other abdominal tergites. Abdominal tergites III to VI (inclusive) fused into one piece; VII separated by a transverse suture; connexival segments separated from one another and from abdominal tergites by sutures, except I and II united. Beneath with three sternal division and first three ventral tergites conjointly fused, other ventrites distinguishable by transverse sutures. Suture between dorsal tergites II and III also apparently fused, and besides the posterior triangular projection of mesonotum appears to be fused to the dorsal surface of metanotum.

Type species, *Apteraradus javanicus* sp. nov.

This peculiar genus may be separated at once from other genera of apterous aradids by the turtlelike appearance of head with long neck, median triangular projection of hind margin of mesonotum and location of stigmata.

APTERARADUS BLOTEI sp. nov. Fig 2.

Obovate, brownish fuscous. Head long, median length twice as long as width across eyes; tylus with a small tubercle near front end; median longitudinal part not quite as wide as one of the lateral shelves, almost occupying one-third of vertex; eyes reddish, rounded, the shelf not extended behind eyes. Labium short, testaceous. Antennæ finely granulate, with very short, pale pubescence; segment I quite stout, bent outward, extending about three-fourths of its length beyond apices of juga; II much slenderer, short; IV moderately enlarged apically, measurements: I, 40; II, 28; III, 64; IV, 27. Legs moderately long, stramineous.

FIG. 2. *Apteraradus blötei* sp. nov., type.

Pronotum almost three times as wide at base as median length (144:50), longitudinal sulcate at middle, with small lateral lobe at each anterolateral corner; collar set-off from pronotum by an obtusely angulate furrow, at widest part (middle) nearly one-half as long as pronotum, with dorsal surface as rugged and rough as pronotum, without

an encircling furrow; mesonotum mostly narrower than pronotum, with outer margins slightly rounded and extended slightly laterally but scarcely lobate, with posterior projection at midline in the form of an isosceles triangle, the sutures separating mesonotum from pro- and metanota indicated by arcuatelike furrows. Abdominal tergite II with a similar pattern of sculpturing as tergites III to VI.

Length, 7.00 mm; width, 3.00 mm.

Holotype (female), Tjibodas, Java, March 25 to 28, 1904, K. Kraeplin, in Rijksmuseum van Natuurlijke Historie, Leiden, Holland. Named in honor of the famous entomologist, Dr. H. C. Blöte, of Leiden.

Genus INDIARADUS novum

Oblong, depressed above, strongly obliquely narrowed from basal part of abdomen anteriorly, with anterior margin of pronotum and width of head across eyes practically equal, with connexival segments tilted slightly upward. Head rather small, subquadrate, with very short neck, beset with rather coarse setalike hairs and coated with an exudate; eyes small, pedicillate, with stalk fairly long, slightly tilted upwards and situated behind middle of head and near end of each lateral shelf; antenniferous tubercles short, divergent, bluntly pointed; lateral shelves thick, a little wider (each shelf) than median longitudinal part of head, with dorsal surfaces of shelves and median part of head on same horizontal level; tylus moderately wide; juga very narrow, strongly compressed laterally, with upper edge (dorsal surface) below dorsal surface of tylus, with flattened tips slightly exceeding apex of and meeting in front of tylus. Labial sulcus short, not extending to neck, labium not attaining apex of sulcus.

Pronotum with a transverse suture separating it from mesonotum, with collar smooth and not inserted; mesonotum, metanotum, and abdominal tergites I and II coalesced, trapezoidal in outline, with sides distinctly obliquely narrowed anteriorly, with a large median longitudinal ridge extending from base to apex, with impressed areas on each side of median ridge. Abdominal tergites III to VI (inclusive) coalesced, truncate at both base and apex, with a large median longitudinal ridge extending its entire length, sculptured on each side of ridge; tergite VII separated by a transverse suture; connexival segments sutured from one another and from abdominal tergites, save I and II united. Body beneath convex, with thoracic

divisions and first three ventrites conjointly fused, the other ventrites separated from one another by sutures. Entire dorsal surface of thorax and abdomen with a complicated pattern of dense rows of matted, short setalike hairs and fibrous exudate encircling depressed areas, on both sides of median longitudinal ridge and other scooped out and sculptured areas, also with longer setalike hairs arranged in tufts outer lateral margins.

Legs long, slender. Stigmata II to VII (inclusive) ventral, rather remotely removed from exterior edge of connexiva, each placed up on end of small rounded elevation, II with elevation directed laterally so that the apex of tubercle and spiracle are plainly visible from dorsal aspect, other elevations directed downward and thus the spiracles are not visible from above; VIII (genital) placed on end of a postero-laterally directed process.

Type species, *Indiaradus crinatus* sp. nov.

Distinguished from other genera having pedicillate eyes by the quadrate head with very short neck, eye-stalk arising from behind the middle of outer side of lateral shelf, laterally compressed and thin juga with apices meeting at midline in front of tylus, trapezoidal form of anterior part of body, non-inserted collar, position of spiracles (especially II) and the decorative, dense row of short, matted, setalike hairs and fibrous exudate on dorsal surface.

INDIARADUS CRINATUS sp. nov.

Oblong, dark reddish ferrugineous, ornated with dense rows of matted setalike hairs and fibrouslike exudate of a dull yellowish brown or tawny color. These rows encircle within rounded impressions, border each side of median longitudinal carina and cover a large part of surface of pro- and mesonota, connexiva and other parts of dorsal surface. Head rather hairy and pretty much covered with exudate, width across eyes and longitudinal length subequal (80:82); tylus and juga short, extending very little beyond apex of antenniferous tubercles; neck very short, strongly constricted, smooth. Antennal segment I longer than II (68:48), other two segments missing.

Pronotum wider across base than in front, longitudinally furrowed at middle, twice as wide at base as median length (120:60); mesonotum shorter and a little wider than pronotum. Legs slightly granulate, coxæ and trochanters distinct.

Holotype (female), Madura Island, Java Sea, East Indies, in Drake Collection.

Easily separated from other apterous aradids of the Orient and East Indies by the shape of body, position of stalked eyes, nature of matted rows of hairs and exudate and stigmata II visible on both sides of body from dorsal aspect.

BOOKS

Books received from time to time by the Philippine Journal of Science are reviewed and acknowledged in this section.

The American Arbacia and other Sea Urchins. By E. B. Harvey. New Jersey, Princeton University Press, 1956. 298 p. Price, $6.00

The aim of the author is to bring together in one volume all the experimental research that has been done on the sea urchin, especially on its embryology, in order to make it more easily available to present-day and future investigators.

The book is divided into four sections. The first one deals with general information on the sea urchin; its history since Greek times, uses, both economic and experimental, description, natural history, and breeding habits.

The second section is concerned with the embryological development, gametogenesis, and metamorphosis. The embryological parts are well illustrated, mostly with original photographs. Detailed descriptions of the characteristics of the immature and mature fertilized egg, sperm, blastula, gastrula, and pluteus, along with experimental findings, are given.

Centrifuging the eggs, in which the author is particularly interested, is covered in the third section. Here much valuable information on experimental methods, properties of egg fractions (halves), and development of centrifuged eggs and egg fractions (halves and quarters) is discussed.

The fourth and last section is an alphabetical compilation of experimental work and data chiefly on the *Arbacia punctulata* egg. Here, in a nutshell, can be found all the experiments performed and data ever obtained from this versatile animal. This makes the book extremely valuable to laboratory researchers.—S. R.

Principles of Embryology. By C. H. Waddington. New York, The Macmillan Company, 1956. 510 pages, 186 figures.

Unlike other books written on embryology, this publication stimulates the thinking of students and workers in this branch of zoology to higher levels of developmental research. It is a valuable book especially for student researchers who have already acquired the basic and fundamental principles of embryo-

logy and are ready to embark on more advanced and critical studies of certain phase or phases of the general subject matter. Such problems as are related to the search for scientific explanations of embryological or developmental facts could be investigated along biochemical trends, using the "genes and such other bodies of similar order of complexity" as the ultimate unit. The role played by the genes as the "ultimate controllers of the whole range of developmental processes" is highly emphasized. It is further pointed out that although "something is now known about the kinds of things genes, or a group of genes, do," still there remains as yet a need for intensive investigations on just "what exactly some one definite gene does and how it produces its effects." It further claims that because the activities of genes, except in very few cases, are still beyond our control we cannot hope to know much about them until such controls are successfully effected.

This book is more than an ordinary textbook of embryology in that while it "attempts to describe in an abbreviated and simplified outline * * * the general framework of embryological science within which the attack on fundamental problems has been made," it further emphasizes points where far-reaching scientific explanations of facts in animal development may yet be made along an entirely different and altogether new method of approach by the employment of experimental procedures in contrast to the non-experimental studies of mere structure and forms.—A. F. U.

Principles of Turbomachinery. By D. G. Shepherd. New York, The Macmillian Co., 1956. 463 p. Price, $10.00

This book deals with the engineering analysis of principles underlying all forms of turbomachines and their basic similarity. In the past, steam and gas turbines, (steam and gas) hydraulic turbines and pumps (water or liquid), and fans and centrifugal compressors (air), have been treated separately in three different texts, but the author believes that it is now due that they should be dealt with in a unified text because of the correlation of the three types in the principles involved in their construction and operation.

He strives to delve on the most general characteristics and basic design elements of all turbomachines first and then on the performance of individual types. He further believes on the generalized method of treatment as the most logical means of

presenting the elements of turbomachinery to achieve the objectives of intelligent selection of machinery for the given duty, appreciating the correct use and operation, evaluation of its performance and introduction to the detailed design of the machinery.

In this book, such generalized treatment is discussed and illustrated in 11 chapters, covering correlation of the different types, energy transfer under the laws of motion and vector diagram, laws governing compressible flow, fluid flow in ducts and around blades, and application of results to most important and recognized types of turbomachinery.—*M. J.*

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PUBLICATIONS AVAILABLE

CONTENTS AND INDEX. THE PHILIPPINE JOURNAL OF SCIENCE, vol. 1 (1906) to vol. 10 (1915). Bureau of Science Publication No. 8 (1917). Paper, 442 pages. Price, $4.00 United States currency, postage extra.

SECOND TEN-YEAR INDEX. THE PHILIPPINE JOURNAL OF SCIENCE, vol. 11 (1916) to vol. 28 (1925). Compiled by Winifred I. Kelley. Bureau of Science Monograph 26. Paper, 382 pages. Price, $4.00 United States currency, postage extra.

CHECKLIST OF THE ANTS (HYMENOPTERA: FORMICIDÆ) OF ASIA. By J. W. Chapman and S. R. Capco. Institute of Science and Technology Monograph 1 (1951) new series. Paper, 327 pages. Price, $2.00 United States currency, postage extra.

NOTES ON PHILIPPINE MOSQUITOES, XVI. GENUS TRIPTEROIDES. By F. E. Baisas and Adela Ubaldo-Pagayon. Institute of Science and Technology Monograph 2 (1952) new series. Paper, 198 pages; with 23 plates and 4 text figures. Price, $2.50 United States currency, postage extra.

A REVISION OF THE INDO-MALAYAN FRESH-WATER FISH GENUS RASBORA. By Martin R. Britian. Institute of Science and Technology Monograph 3 (1953) new series. Paper, 224 pages, with 8 plates and 52 text figures. Price, $2.50 United States currency, postage extra.

NOTE TO CONTRIBUTORS

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